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Revision of *Therophilus* s.s. (Hymenoptera, Braconidae, Agathidinae) from Thailand

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Abstract

Based on a phylogenetic analysis, the limits of *Therophilus* (Hymenoptera: Braconidae: Agathidinae) are redefined and restricted to a small proportion of the previously included species. Those species belonging to the world fauna are listed and the species from Thailand are revised. Forty-four species are assigned to the genus including 11 new species, i.e. *T. anuchati*, *T. apichati*, *T. areeluckae*, *T. boonthami*, *T. chiangmaiensis*, *T. kwanuiae*, *T. songrami*, *T. sukpengae*, *T. wannai*, *T. wongchaii*, *T. wongwani*. A dichotomous key to species is presented; links to an electronic interactive key and to distribution maps are also included.

Keywords

Thailand, Insecta, identification key, taxonomy, systematics

Introduction

Agathidinae is a moderately large subfamily of Braconidae with 1,069 described species worldwide and 246 in the Oriental Region (Yu et al. 2005), though there are an estimated 2,000–3,000 species awaiting description worldwide (Sharkey et al. 2006). The subfamily has a worldwide distribution and members are found in most terrestrial habitats. The history of higher classification of the Agathidinae was summarized by

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Sharkey (1992) who also proposed a tribal level classification based on ground-plan coding. Sharkey et al. (2006) conducted phylogenetic analyses based on morphology and the D2–D3 regions of 28S rDNA. The Oriental fauna of Agathidinae were first revised by Bhat and Gupta (1977) and they provided a detailed history of taxonomic research for the area. Sharkey et al. (2009) revised the Oriental genera of Agathidinae. Van Achterberg and Long (2010) revised the Vietnamese agathidine fauna. Sharkey and Clutts (2011) revised the Thai species of *Biroia*, *Braunsia*, *Camptothlipsis*, *Coccygidium*, *Cremnops*, *Cremnoptoides*, *Disophrys*, *Earinus*, *Gyrochus*, *Lytopylus*, and *Troticus*, and included a key to the Agathidinae genera of the Oriental region. Sharkey and Stoelb (in press) revised the Thai species of *Zelodia*. This paper is the third in a series to revise all Thai species of Agathidinae. The *genera Aneurobracon*, *Bassus s.s.*, *Euagathis*, and *Therophilus s.l.* will be dealt with in subsequent publications.

Methods

As part of the inventory of Thai insects, we ran 3 Malaise traps at each of 30 different localities throughout Thailand from 2007-2010, comprising approximately 90 Malaise traps. The specimens dealt with here are primarily from these traps.

Species concepts are based on morphological data and 28S rDNA data. Regions D2-D3 of 28S rDNA (roughly 560 base pairs) were sequenced using the following primers: 28SD2hymF 5' - AGAGAGAGTTCAAGAGTACGTG - 3' and 28SD-3hymR 5' - TAGTTCACCATCTTTCGGGTC - 3'. Sequences were edited using Geneious Pro v4.7.5 (Drummond et al. 2009) and aligned based on a secondary structure model for Ichneumonoidea developed by Yoder and Gillespie (2004) and Gillespie et al. (2005). Regions of expansion and contraction (RECs), regions of slipped-strand compensation (RSCs), and short regions of alignment ambiguity were further aligned/corrected by eye. Three of these regions (~30 base pairs total) were deleted because they could not be aligned with any confidence, i.e., there were multiple equally supported alignment options.

Phenetic and phylogenetic trees were constructed using neighbor-joining (NJ), maximum parsimony (MP) and Bayesian methods. MP was performed using TNT (Goloboff et al. 2008) [traditional search with 100 random addition sequences followed by branch-swapping, saving 100 trees per replication; 1000 bootstrap replications were used to estimate branch reliability]. The Bayesian analysis was performed using MrBayes v3.1.2 (Ronquist and Huelsenbeck 2003). Best-fitting DNA substitution models were determined using MrModeltest2.2 (Nylander 2004). The general time reversible model of evolution with a parameter for invariant sites and rate heterogeneity modelled under a gamma distribution (GTR+I+G) was determined as the best-fitting model. The Bayesian analysis consisted of two independent Bayesian MCMC runs initiated from different random starting trees. The analysis ran for 5,500,000 generations, reaching a topological similarity criterion of 0.01; trees were sampled every 500 generations. 25% of the trees from each run were removed as burn-in upon topological

Figure 1. Map showing *Therophilus* collection sites in Thailand.

convergence. The NJ tree was produced from PAUP* (Swofford 2003) using default settings. Figure 2 presents the NJ tree, which was more resolved than the phylogenetic trees produced by MP and Bayesian analyses. We mapped the support values of the Bayesian and MP analyses on the NJ tree.

The dichotomous key, descriptions, and the interactive key (Appendices 1–3) were generated using DELTA Editor (Dallwitz et al. 1999), DELTA (Dallwitz et al. 1993), and Intkey (Dallwitz et al. 1995).

Morphological terms follow Sharkey and Wharton (1997) except for the following: measurements are given for the length and apical width of the first metasomal mediotergite (MT1). Measurement of the apical width is straightforward, however since the base of the tergite is usually hidden from view it is difficult to measure the total length. Instead we measure from the apex of the large tendon that emanates from the propodeum and inserts near the base of the median tergite. Abbreviations used in text: MT1, MT2, MT3...MT7: metasomal mediotergite 1, 2, 3...7.

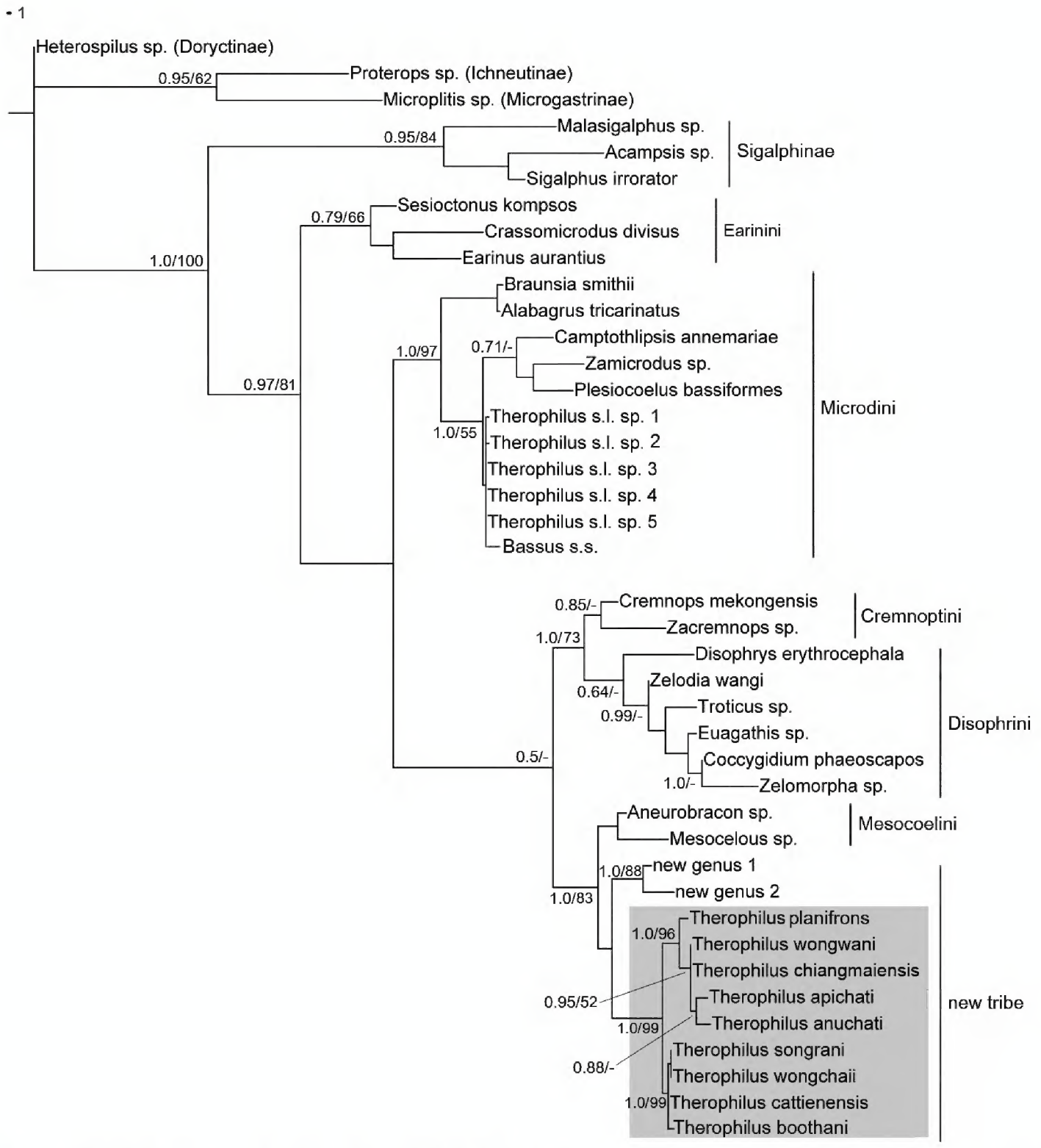


Figure 2. NJ phylogram based on 28S rDNA. Where Bayesian and parsimony analyses agreed with the NJ tree, branch support values are included in the figure, i.e., Bayesian posterior probabilities/parsimony bootstrap (values below 0.5 posterior probability and/or 50% bootstrap support were not recorded on the tree). *Therophilus s.s.* highlighted in grey box.

Morphological terms used in this revision were matched to the Hymenoptera Anatomy Ontology (HAO, Yoder et al. 2010) (Appendix 4). Identifiers (URIs) in the format http://purl.obolibrary.org/obo/HAO_XXXXXXX represent anatomical concepts in HAO version http://purl.obolibrary.org/obo/hao/2011-05-18/hao.owl. They are provided to enable readers to confirm their understanding of the anatomical structures being referenced. To find out more about a given structure, including, images, references, and other metadata, use the identifier as a web-link, or use the HAO:XXXXXXX (note colon replaces underscore) as a search term at http://glossary.hymao.org.

All 14 species found in Thailand are treated with a diagnosis and distributional data. They are illustrated with color photos using a JVC digital camera mounted on a Leica MZ16 microscope and Automontage® stacking software. Distributional data are listed for all species and a Google map via Berkeley Mapper is included for all species. The descriptions are of the holotype and variation is given in parentheses.

The source files for the keys, descriptions, illustrations, DNA sequence and distributional data are all freely available to future researchers who may wish to build on these data. Distribution data, pdf's of non-copywrite references, images, notes, and host and type information can be found by searching Taxabank (a combined specimen and taxonomic database; http://purl.org/taxabank). Codes beginning with an "H" and followed by numbers are unique identifiers used for specimens in the Sharkey lab at the University of Kentucky, and in the specimen database TaxaBank (e.g., H235). All sequences have been deposited in the GenBank database.

Abbreviations used for specimen depositories are as follows:

HIC Hymenoptera Institute Collection, University of Kentucky, Department of Entomology, Lexington, Kentucky, USA.
QSBG Queen Sirikit Botanic Gardens, Chiang Mai, Thailand.
RMNH NCB Naturalis Collection [formerly Rijksmuseum van Natuurlijke Historie], Leiden, Netherlands.
IRSNB Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium.

Results

Phylogeny

Recently the polyphyletic generic concept, *Bassus*, was divided into four genera, i.e., *Bassus s.s.*, a small monophyletic group confined to the Old World, *Lytopylus*, a large monophyletic group with a world-wide distribution, *Neothlipsis*, a small New World genus and *Therophilus*, a polyphyletic dumping ground for the remaining species. Here we refine the concept of *Therophilus* so that it is monophyletic. However, this leaves those species that do not fit the concept without a correct generic placement. We refer to these as *Therophilus* s.l. in this treatment, and they will be treated in a separate publication (Sharkey et al. in prep).

The phylogenetic tree in figure 2 shows that *Therophilus* in the strict sense, and two new genera, are far removed from the majority of the species of *Therophilus sensu latu*. The clade containing *Therophilus s.s.* was referred to as an unnamed new tribe in Sharkey (1996). The monophyly of all agathidine tribes is well supported, though the tribal interrelationships based on 28S remain volatile.

Within *Therophilus s.s.*, there are two distinct clades that may deserve generic status when more is known of their biology and diversity. All members of the lower clade,

in figure 2, which includes *T. cattienensis,* are stout and mostly yellow-orange, e.g., all have predominantly yellow-orange heads. *Therophilus conspicuous* Wesmael, the type species, belongs in this group. Members of the clade containing *T. chiangmaiensis* are more gracile and melanic.

Therophilus Wesmael, 1837

http://species-id.net/wiki/Therophilus

Type species. *Microdus (Therophilus) conspicuous* [Lectotype ♀ IRSNB, examined]

Diagnosis. There is neither one character nor a specific combination of characters that distinguishes members of *Therophilus* from all other agathidines. It is easily separated from members of Cremnoptini and Disophrini by the shape of the tarsal claws, i.e., simple with a basal lobe in *Therophilus,* versus cleft claws in members of the two aforementioned tribes. Most members of *Therophilus* have the following combination of diagnostic characters: Apical abscissa of R of fore wing weak at midlength and bent towards apex of wing; interantennal space with two (usually weak and short) longitudinal ridges or with a median keel; postscutellar depression present; cubitus of hind wing strong and tubular, at least basally; subbasal cell of hind wing angled apically at the point from which the cubitus emanates; sclerite between hind coxal cavities and metasomal foramen incomplete or narrow. A combination of characters that distinguishes almost all species of Oriental *Therophilus* is: Interantennal space with longitudinal groove (Figs. 3c, 6c), sometimes weak (Fig. 8c); posteroscutellar depression present (Fig. 8f); notauli sculptured with pits (Fig. 3f).

Description. Head. Lateral carina on frons absent (Fig. 3c); interantennal space with longitudinal groove (Fig. 3c, 6c); gena not extended ventroposteriorly into sharp prominence (Fig. 5e); gena lacking sharp angle posteriad eye; labial palpus with three or four segments, third segment much reduced or absent; apical antennomere acute but lacking nipple-like process.

Mesosoma. Propleuron lacking a projection at mid height; notauli impressed and pitted, at least in part (Fig. 3f); posteroscutellar depression present (Fig. 8f) (rarely absent); propodeum from rugose to areolate-rugose (Fig. 7g); sclerite between hind coxal cavities and metasomal foramen narrow, sometimes incomplete.

Legs. Fore tibia lacking pegs, fore tarsal claws with basal lobe; mid tibia with apical and medial pegs; hind tibia with apical pegs.

Wings (Figs. 3b, 4b)**.** Fore wing RS + M vein incomplete; second submarginal cell triangular; fore wing 3RSb decurved, weak at midlength; hind wing r and r-m crossveins absent; hind wing CUb present and strong, tubular at least basally.

Metasoma. MT1 with longitudinal striations, lacking dominant pair of longitudinal carinae (Fig. 4f); MT2 from smooth to striate, usually with some longitudinal striae and weak transverse striae in first transverse depression; MT3 smooth (Fig. 4f); ovipositor as long as or longer than metasoma (Fig. 4a).

Species diversity. Including the twelve described here, there are 44 described species known to the senior author. The following 13 species were included in *Therophilus* at the time of this publication: *Therophilus antipoda* Ashmead, 1900, *Therophilus arcuatus* Reinhard, 1867, *Therophilus cattienensis* van Achterberg & Long, 2010, *Therophilus cingulipes* Nees, 1812, *Therophilus clausthalianus* Ratzeburg, 1844, *Therophilus conspicuus* Wesmael, 1837, *T. crenulisulcatus* van Achterberg & Long, 2010, *Therophilus levisoma* van Achterberg & Long, 2010, *Therophilus planifrons* van Achterberg & Long, 2010, *Therophilus rugosiferus* van Achterberg & Long, 2010, *Therophilus similis* (Bhat & Gupta, 1977), *Therophilus stephensae* Stevens, 2011, *Therophilus tumidulus* (Nees, 1812).

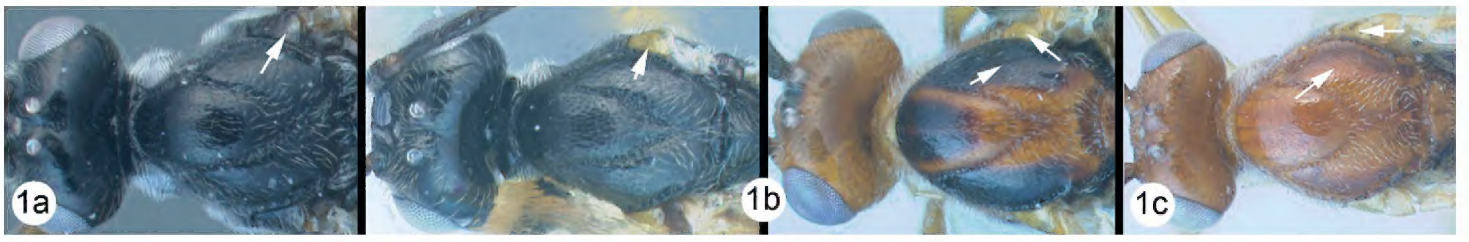
The remainder are here transferred to *Therophilus*: *Bassus arthurellus* Sharkey 1985 = *Therophilus arthurellus* comb. n., *Bassus belokobylskiji* Sharkey, 1998 = *Therophilus belokobylskiji* comb. n., *Agathis bruesi* Shenefelt, 1970 = *Therophilus bruesi* comb. n., *Agathis curvabilis* Bhat & Gupta, 1977 = *Therophilus curvabilis* comb. n., *Agathis cymocles* Nixon, 1950 = *Therophilus cymocles* comb. n., *Agathis flava* Bhat & Gupta, 1977 = *Therophilus flavus* comb. n., *Bassus graecus* Simbolotti & van Achterberg, 1992 = *Therophilus graecus* comb. n., *Agathis hyalinis* Bhat & Gupta, 1977 = *Therophilus hyalinis* comb. n., *Microdus infumatus* Granger, 1949 = *Therophilus infumatus* comb. n., *Microdus insularis* Ashmead = *Therophilus insularis* comb. n., *Bassus lanyuensis* Chou & Sharkey, 1989 = *Therophilus lanyuensis* comb. n., *Microdus nugax* Reinhart, 1867 = *Therophilus nugax* comb. n., *Microdus simillimus* Cresson, 1873 = *Therophilus similimus* comb. n., *Microdus tautirae* Cheeseman, 1928 = *Therophilus tautirae* comb. n., *Bassus tegularis* Thompson, 1895 = *Therophilus tegularis* comb. n., *Bassus tobiasi* Sharkey, 1998 = *Therophilus tobiasi* comb. n., *Agathis triangularis* Szépligeti = *Therophilus triangularis* comb. n., *Bassus triangulus* Chou & Sharkey, 1989 = *Therophilus triangulus* comb. n., *Microdus postfurcalis* Szépligeti, 1914 = *Therophilus postfurcalis* comb. n., *Microdus zaykovi* Nixon = *Therophilus zaykovi* comb. n. There are many species of Agathidinae currently placed in *Therophilus* and *Bassus* Fabricius which belong to other genera, and many more that are yet to be described.

Biology. According to Nixon (1986), *T. conspicuus* attacks larval Tortricidae. Janzen has reared three species of *Therophilus s.s.* in Costa Rica; they are parasitoids of Tortricidae and Elachistidae. See parasitoid DHJPAR voucher numbers 0039084, 0038338, and 0040068 in the "caterpillars of Guanacaste" database at http://janzen.sas.upenn.edu/caterpillars/database.lasso

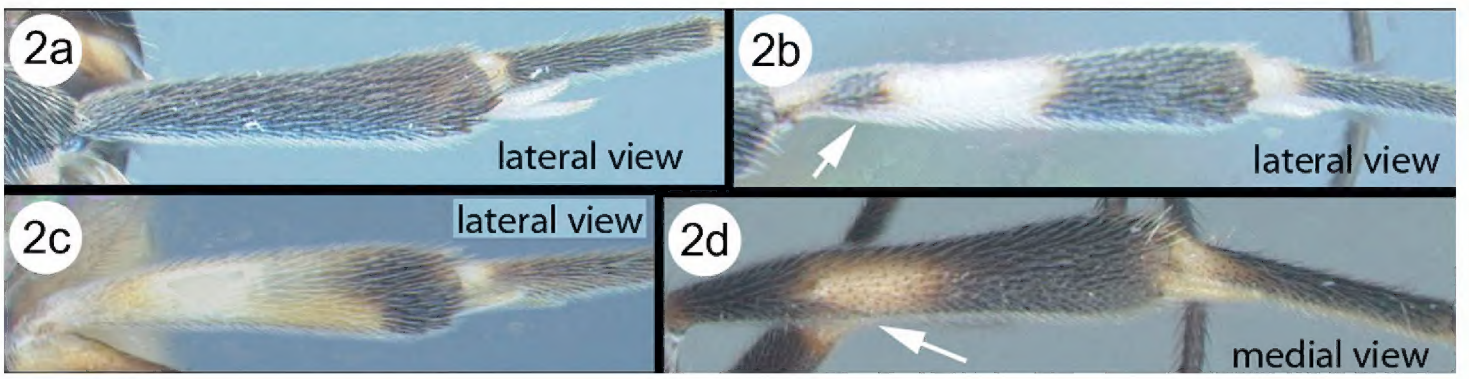
Distribution. Worldwide, with more diversity in subtropical and tropical areas.

Key to Thai species of *Therophilus s.s.*

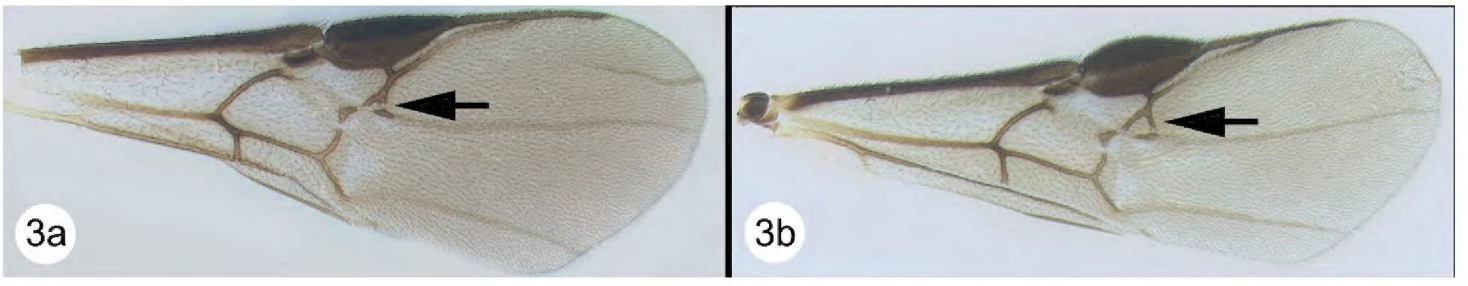
1 a. Tegula black, concolorous with mesoscutum..... **2**
b. Tegula yellow, contrasting with predominantly black mesoscutum..... **8**
c. Tegula yellow or orange, similar in color to predominantly orange or yellow mesoscutum **12**



2(1) a. Hind tibia entirely melanic (check medial surface) .... ***T. anuchati*** **Sharkey sp. n.**
b. Hind tibia largely pale, melanic apically and with a subbasal melanic band or lateral spot **3**
c. Hind tibia mostly pale, melanic apically only .... ***T. kwanuiae*** **Sharkey sp. n.**
d. Hind tibia mostly melanic with pale coloration at midlength at least medially ..... ***T. chiangmaiensis*** **Sharkey sp. n.**

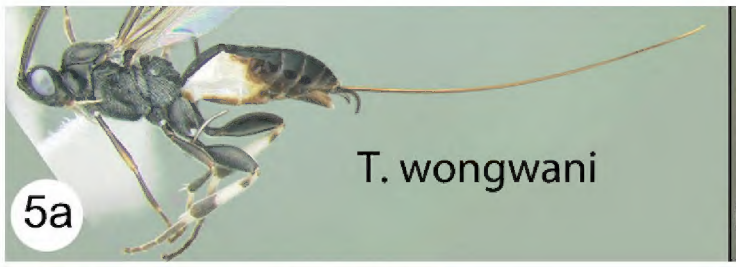


3(2) a. 2nd submarginal cell reduced to a small dot, petiole longer than cell is high **4**
b. 2nd submarginal cell larger, cell height subequal to petiole length **6**

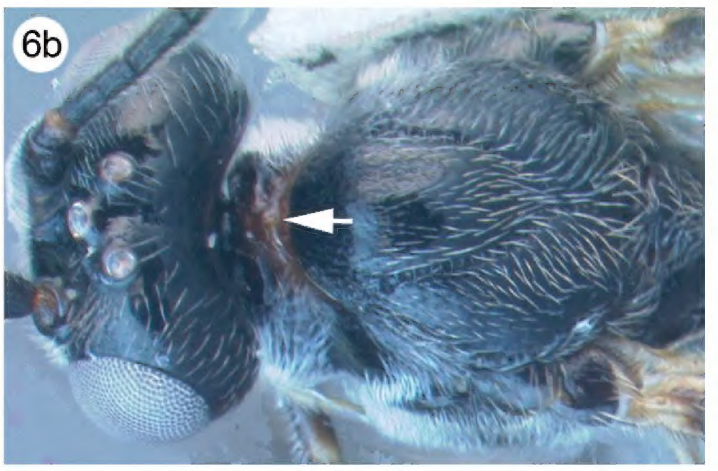


4(3) a. Fore tarsus mostly or entirely melanic **5**
b. Fore tarsus mostly or entirely pale..... ***T. kwanuiae*** **Sharkey sp. n.**

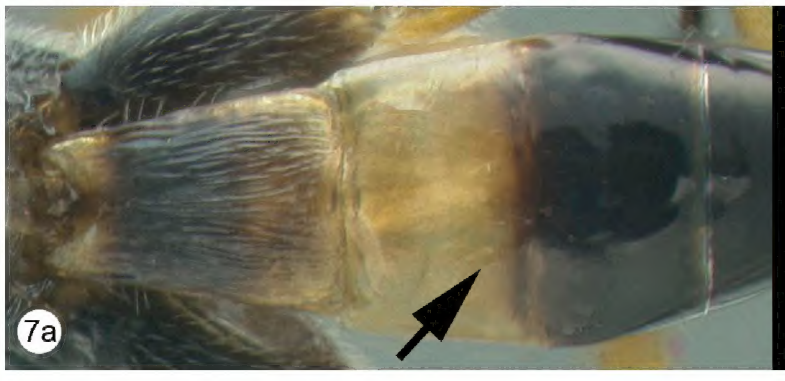
5(4) a. Exposed portion of ovipositor distinctly longer than body .... ***T. wongwani*** **Sharkey sp. n.**
b. Exposed portion of ovipositor slightly shorter than body .... ***T. levisoma*** **van Achterberg & Long**

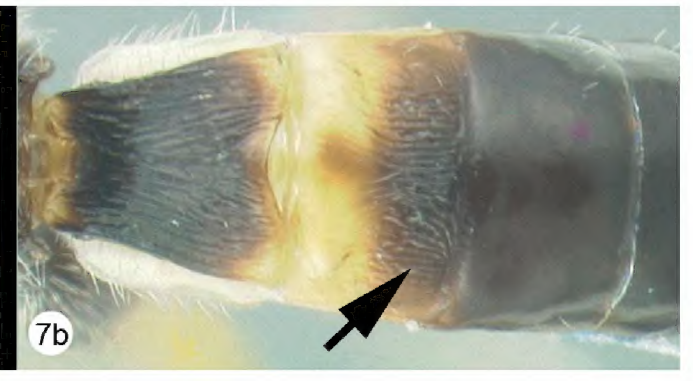


6(3) a. Pronotum entirely melanic.....7
b. Pronotum mostly melanic but pale dorsomedially.....
.....***T. wannai*** **Sharkey sp. n.**

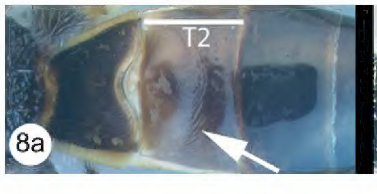


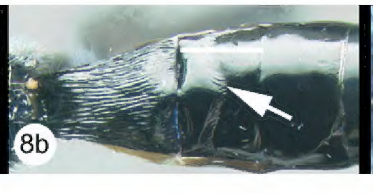
7(6) a. Posterior half of MT2 smooth.....
.....***T. crenulisulcatus*** **van Achterberg & Long**
b. Posterior half of MT2 longitudinally striate, at least medially .....
..... ***T. sukpengae*** **Sharkey sp. n.**

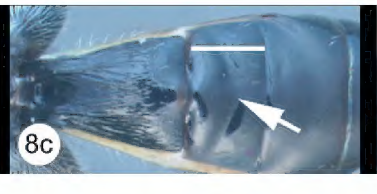


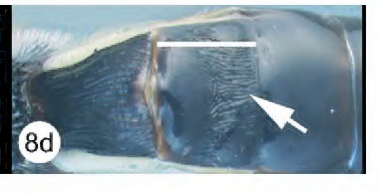


8(1) a. MT2 mostly smooth with transverse and/or diagonal striae in and/or near transverse depression..... ***T. wongchaii*** **Sharkey sp. n.**
b. MT2 mostly smooth with short longitudinal striae restricted to transverse depression…..... ***T. planifrons*** **van Achterberg & Long**
c. MT2 entirely smooth.....**9**
d. MT2 smooth in most of anterior half anteriad transverse groove, longitudinally striate in transverse groove and area posteriad transverse groove, at least medially. **10**

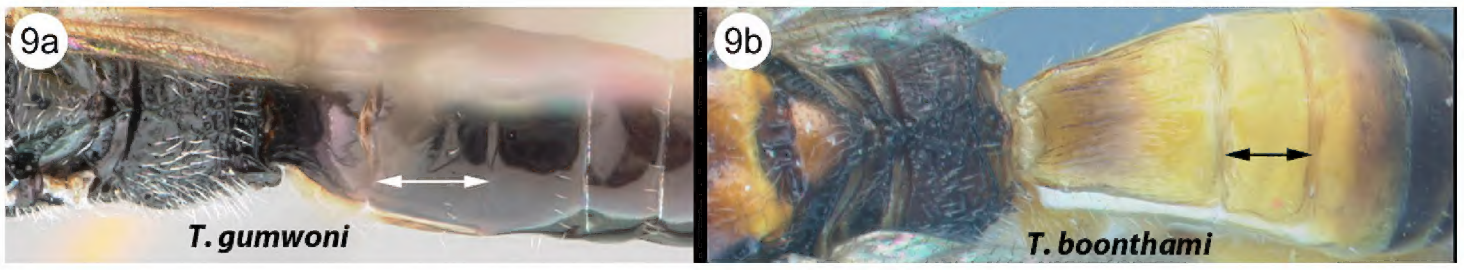




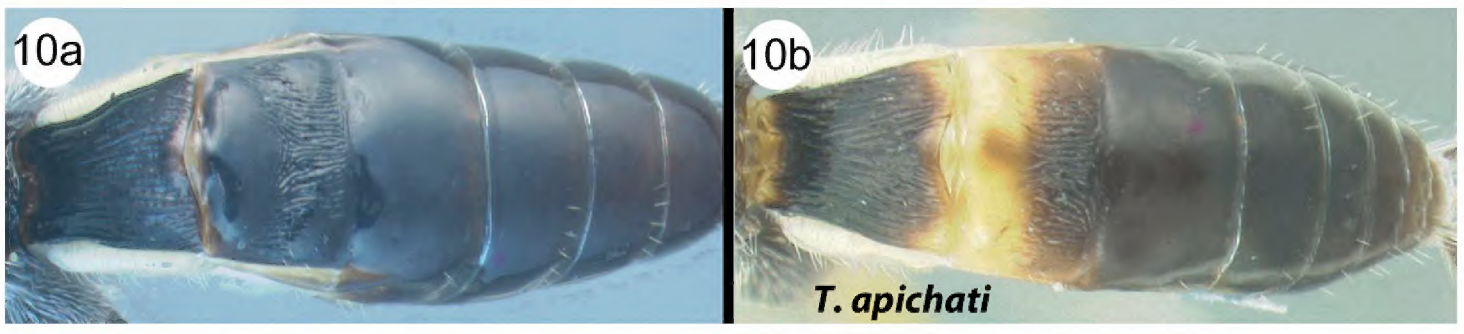




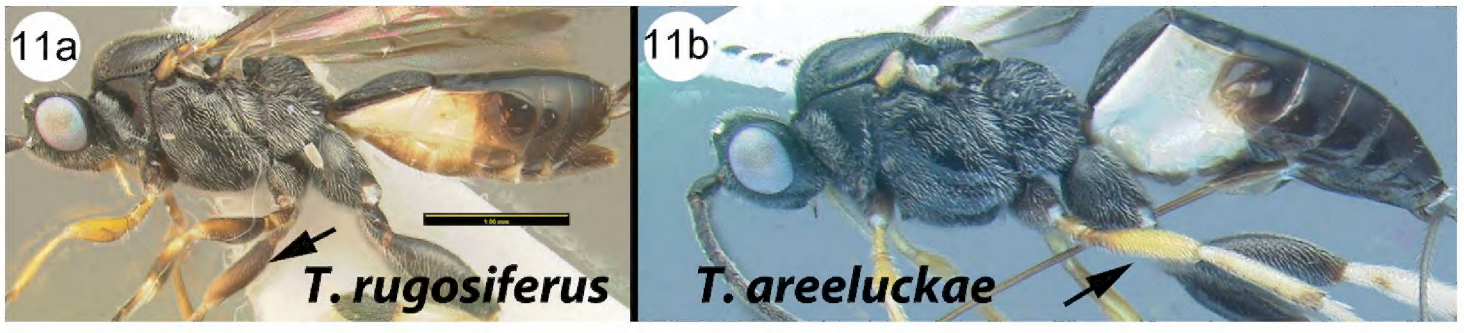
9(8) a. MT2 entirely melanic ..... ***T. planifrons*** **van Achterberg & Long**
b. MT2 entirely or almost entirely pale..... ***T. boonthami*** **Sharkey sp. n.**



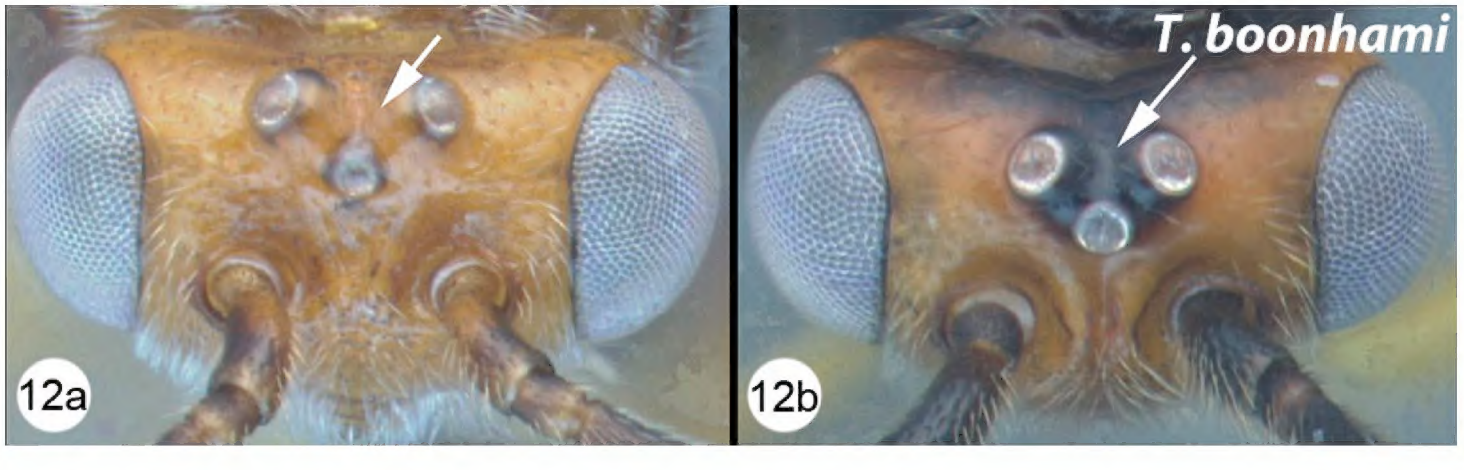
10(8) a. MT2 entirely melanic **11**
b. MT2 pale in anterior half, melanic posteriorly.....
..... ***T. apichati*** **Sharkey sp. n.**



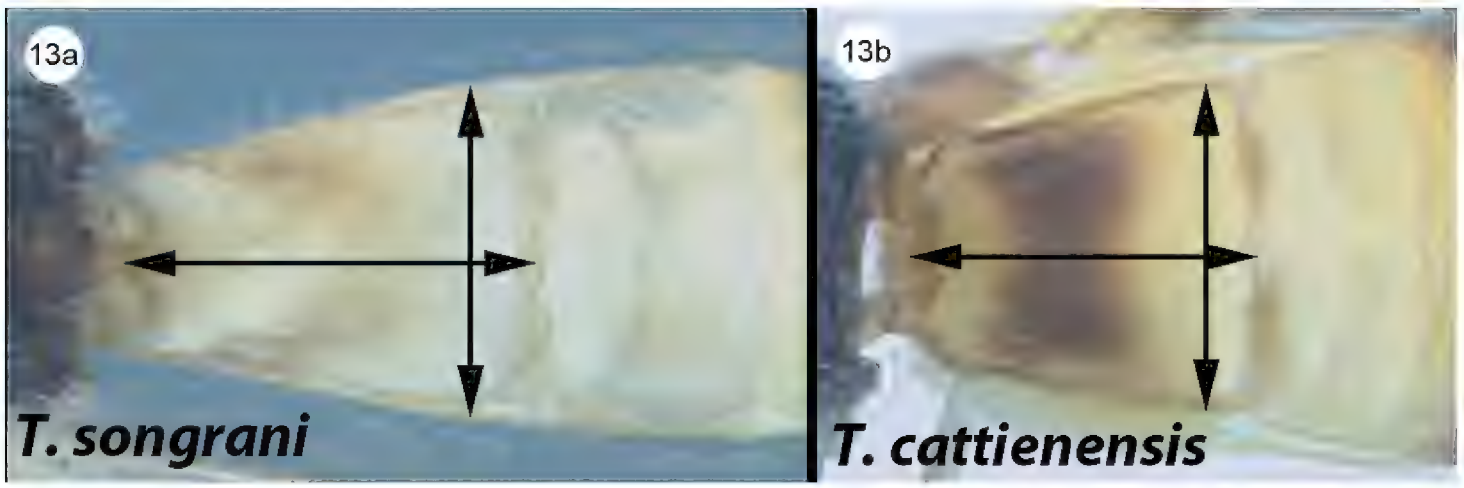
11(10) a. Mid femur mostly or entirely melanic, usually pale distally .....
..... ***T. rugosiferus*** **van Achterberg & Long**
b. Mid femur entirely or mostly pale, usually melanic at extreme base .....
..... ***T. areeluckae*** **Sharkey sp. n.**



12(1) a. Ocellar triangle pale, concolorous with remainder of vertex **13**
b. Ocellar triangle melanic, contrasting with most of vertex.....
..... ***T. boonthami*** **Sharkey sp. n.**



13(12) a. MT1 length distinctly longer than apical width .....
..... ***T. songrani*** **Sharkey sp. n.**
b. MT1 length only slightly longer than apical width .....
.....***T. cattienensis*** **van Achterberg & Long**



Species Treatments

Therophilus anuchati **Sharkey sp. n.**
urn:lsid:zoobank.org:act:134DEB0E-168C-4B81-94C4-A82CC11346DA
http://species-id.net/wiki/Therophilus_anuchati
Figure 3

Diagnosis. Ocellar triangle melanic, concolorous with remainder of vertex. Hind tibia entirely melanic. Strong transverse carinae between the hind coxal cavities and a wide sclerite between the hind coxal and metasomal foramina. Strong, sharply declivous longitudinal flange between antenna; hind wing CUb strong and long; median lobe of mesoscutum sharply sloping anteriorly.

Description. Body length. 5.2 mm.

Head. Space between antennal insertions with a well-developed keel that is sharply declivous posteriorly, dorsal surface of keel with a shallow longitudinal groove. Number of flagellomeres 32. Posterior surface of scutellum completely rugose, posterior scutellar depression not distinct.

Mesosoma. Number of pegs on mid tibia = 4. Number of pegs on hind tibia = 9. Sclerite between metasoma and hind coxa wide with a high ridge along most or all of its length. Basal lobe of hind tarsal claw longer than high, not sharply declivous. Length-width of hind femur 1.0/0.342 = 2.9. 2nd submarginal cell large, cell height subequal to petiole length. Hind wing vein Cub emanates from near mid length of apical margin of subbasal cell, Cub long and strong. Point of notauli intersection heavily sculptured over a wide area with a median longitudinal ridge. Median lobe of mesoscutum bulging and sharply declivous anteriorly. Metapleuron with dense mat of white setae.

Metasoma. MT1 length distinctly longer than apical width. MT1 with widely-spaced longitudinal striae, lacking microsculpture between striae, and with and two pairs of distinctly stronger striae (carinae). MT1 distinctly wider apically than basally.

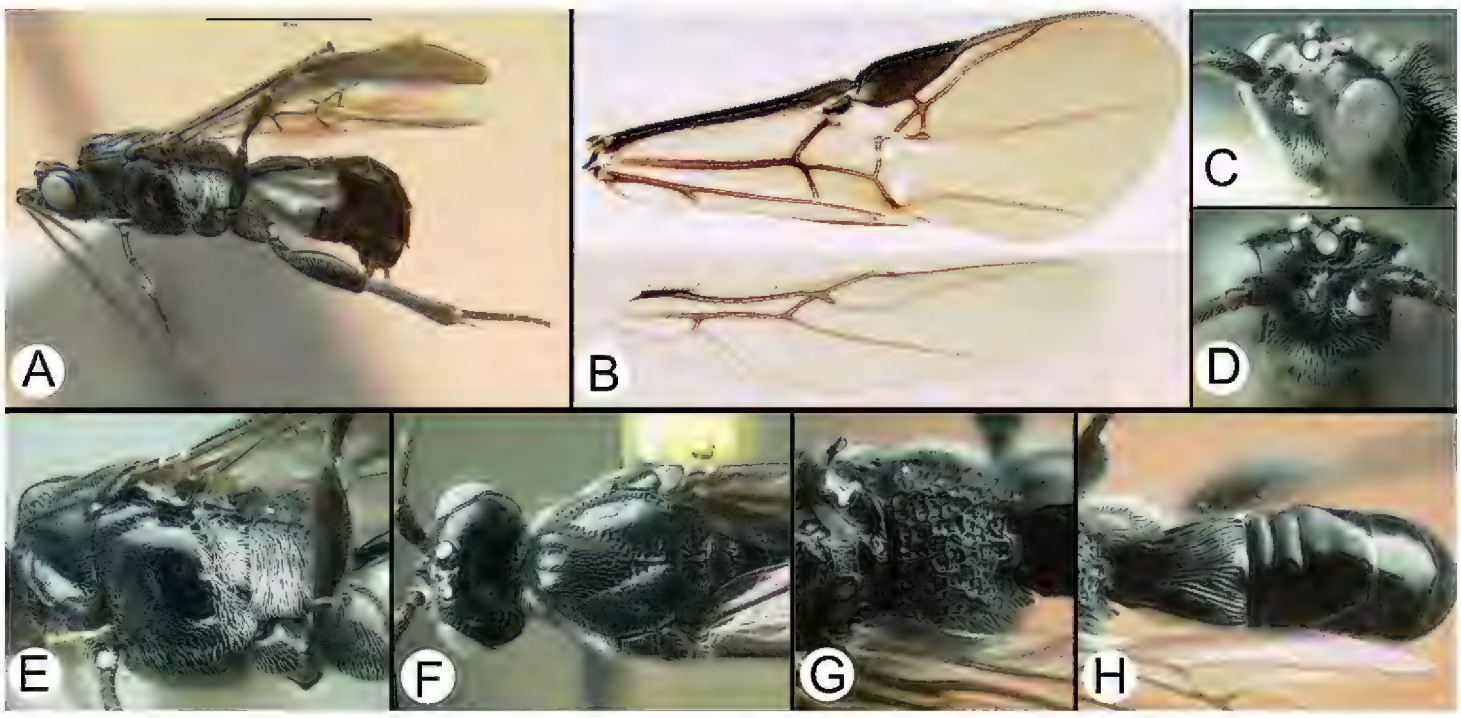


Figure 3. *Therophilus anuchati* sp. n. **a** lateral habitus **b** Wings **c** dorsolateral head **d** anterodorsal head **e** lateral mesosoma **f** dorsal head and mesosoma **g** dorsal propodeum **h** dorsal metasoma.

Ratio of widest point of MT1 to narrowest point 0.61/0.411 = 1.5. Length-width ratio of MT1 0.8/0.61 = 1.3. MT2 entirely smooth.

Color. Mostly black or dark melanic except for dense white pilosity on metapleuron and white on anterior lateral tergites and sternites, more apical leg segments lighter, tending towards light brown or dark yellow, all apical spurs white, mandible and palpi mostly yellow, fore wing lightly infuscate, stigma brown with a small pale patch near base. Tegula black, concolorous with mesoscutum. Ocellar triangle melanic, concolorous with remainder of vertex. Hind tibia entirely melanic. MT2 entirely melanic.

Etymology. Named in honor of Mr. Anuchat Chaimuangchuen, collector for the TIGER project at Huay Namdung National Park.

Molecular data. H099, GenBank Accession: JQ929184.

Distribution. Distribution map can be found at http://purl.org/thaimap/anuchati

Material examined. Holotype ♂. H099 [QSBG] Thailand, Phu Ruea NP, Nature trail, 920m, 17.48°N, 101.354°E, MT, 12–19.i.2007. http://purl.org/taxabank/T. anuchati

***Therophilus apichati* Sharkey sp. n.**
urn:lsid:zoobank.org:act:5D8F3F04-C77B-482D-A015-4C61204E36F9
http://species-id.net/wiki/Therophilus_apichati
Figure 4

Diagnosis. MT2 pale in anterior half, melanic posteriorly. Ocellar triangle melanic, concolorous with remainder of vertex.

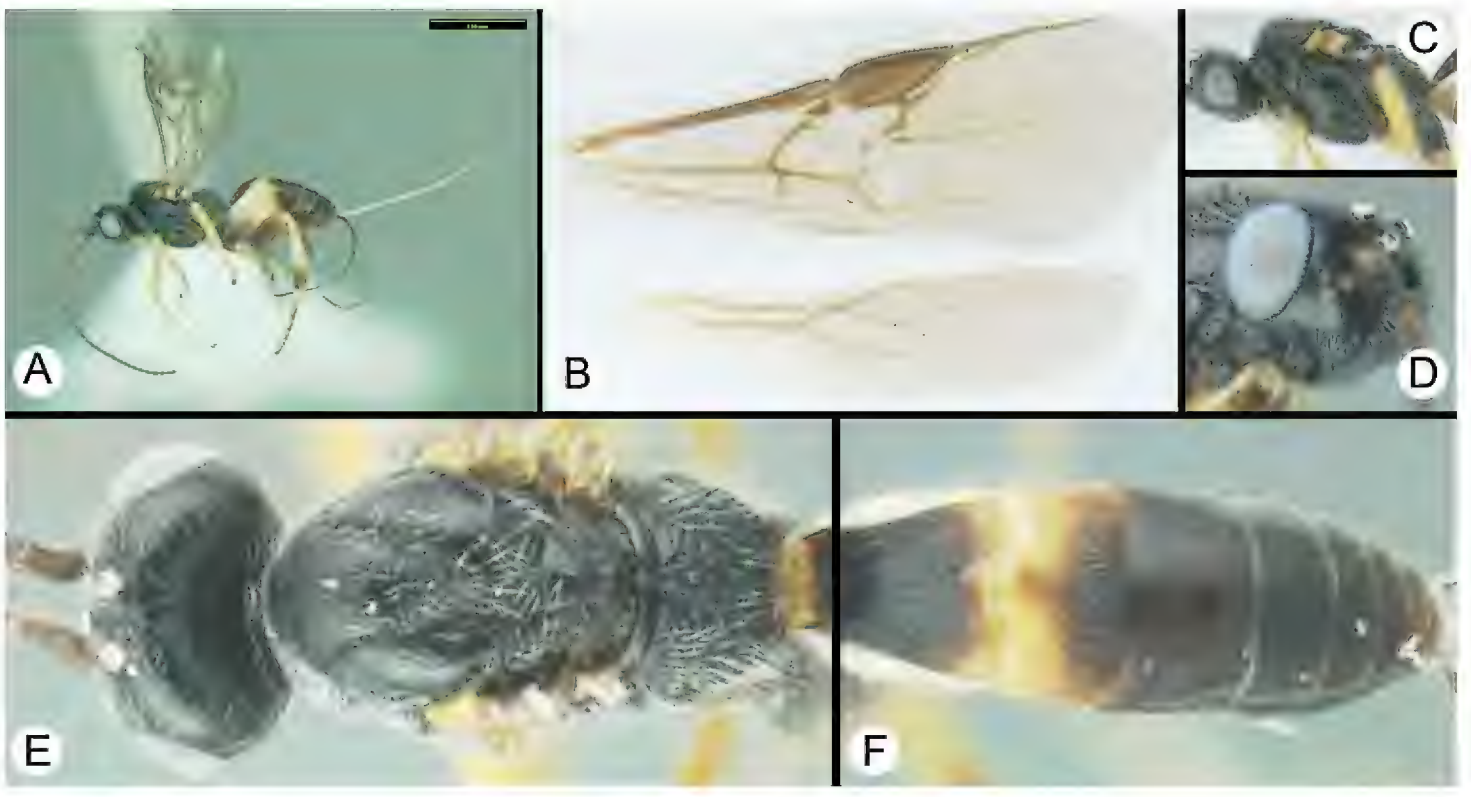


Figure 4. *Therophilus apichati* sp. n. **a** lateral habitus **b** Wings **c** lateral head and mesosoma **d** dorsolateral head **e** dorsal head, mesosoma and propodeum **f** dorsal Metasoma.

Description. Body length. 2.6 mm.

Head. Space between antennal insertions with a weakly developed bulge that is weakly declivous posteriorly, dorsal surface of bulge with a shallow longitudinal groove. Number of flagellomeres 23. Posterior surface of scutellum mostly smooth, posterior scutellar depression well-defined by two large pits separated by a short longitudinal ridge.

Mesosoma. Number of pegs on mid tibia = 5. Number of pegs on hind tibia = 9. Sclerite between metasoma and hind coxa narrow, and lacking a high ridge along its length. Length-width of hind femur 0.596/0.24 = 2.5. 2nd submarginal cell reduced to a small dot, petiole longer than cell is high, or large, cell height subequal to petiole length. Hind wing vein Cub emanates from near mid length of apical margin of subbasal cell, Cub short and weak. Point of notauli intersection heavily sculptured over a wide area. Median lobe of mesoscutum not bulging and not sharply declivous anteriorly. Metapleuron with scattered white setae.

Metasoma. MT1 length distinctly longer than apical width. MT1 with narrowly-spaced longitudinal striae, with some microsculpture between striae, and lacking two pairs of distinctly stronger striae (carinae). MT1 distinctly wider apically than basally. Ratio of widest point of MT1 to narrowest point 0.32/0.22 = 1.5. Length-width ratio of MT1 0.44/0.32 = 1.4. MT2 smooth in most of anterior half anteriad transverse groove, longitudinally striate in transverse groove and area posteriad transverse groove, at least medially. Ovipositor much longer than metasoma, about as long as body or longer.

Color. Body mostly melanic, legs mostly pale; body black except as follows: antenna brown, palpi, labrum and other mouthparts yellow, tegula yellow, fore and mid legs entirely yellow, hind coxa mostly black, hind femur mostly brown, paler apically, hind trochanter, tibia, and tarsus mostly yellow, metasomal mediotergite yellow in an-

terior half or more, anterior metasomal laterotergites and sternites pale yellow. Tegula yellow, contrasting with predominantly black mesoscutum. Ocellar triangle melanic, concolorous with remainder of vertex. Hind tibia mostly pale, melanic apically and with a subbasal melanic band or lateral spot, or mostly pale, melanic apically only. MT2 pale in anterior half, melanic posteriorly.

Etymology. Named in honor of Mr. Apichat Watanawanit, collector for the TIGER project at Doi Chiangdao Wildlife Sanctuary.

Molecular data. H147, GenBank Accession: JQ929183.

Distribution. Distribution map can be found at http://purl.org/thaimap/apichati

Material examined. Holotype ♀. H147 [QSBG] Thailand, Khao Kho NP, Mixed deciduous forest, 560m, 16.542°N, 101.042°E, MT, 19–26.xii.2006. http://purl.org/taxabank/T.apichati

Therophilus areeluckae Sharkey sp. n.

urn:lsid:zoobank.org:act:10482AB4-959F-43A7-8E16-88AE03683437
http://species-id.net/wiki/Therophilus_areeluckae
Figure 5

Diagnosis. MT2 smooth in most of anterior half anteriad transverse groove, longitudinally striate in transverse groove and area posteriad transverse groove, at least medially. Mid femur mostly pale with a bit of melanic color at extreme base. MT2 entirely melanic. Similar to *Therophilus rugosiferus* but *T. areeluckae* has no transverse ridge on the propodeum, more sculpture on mesoscutum, and the fore and middle legs are paler.

Description. Body length. 4.0 mm.

Head. Space between antennal insertions with a weakly developed bulge that is weakly declivous posteriorly, dorsal surface of bulge with a shallow longitudinal groove. Number of flagellomeres 28. Posterior surface of scutellum rugose over a semicircular area that represents the scutellar depression.

Mesosoma. Number of pegs on mid tibia = 5. Number of pegs on hind tibia = 9. Sclerite between metasoma and hind coxa wide with a high ridge along most or all of its length. Length-width of hind femur 0.815/0.256 = 3.2. 2nd submarginal cell reduced to a small dot, petiole longer than cell is high, or large, cell height subequal to petiole length. Hind wing vein Cub emanates from near anterior apex of apical margin of subbasal cell, Cub short and weak. Point of notauli intersection heavily sculptured over a wide area. Median lobe of mesoscutum not bulging and not sharply declivous anteriorly.

Metasoma. MT1 length distinctly longer than apical width. MT1 with narrowly-spaced longitudinal striae, with some microsculpture between striae, and lacking two pairs of distinctly stronger striae (carinae). MT1 distinctly wider apically than basally. Ratio of widest point of MT1 to narrowest point 0.414/0.278 = 1.5. Length-width ratio of MT1 0.668/0.414 = 1.6. MT2 smooth in most of anterior half anteriad transverse groove, longitudinally striate in transverse groove and area posteriad transverse groove, at least medially. Ovipositor much longer than metasoma, about as long as body or longer.

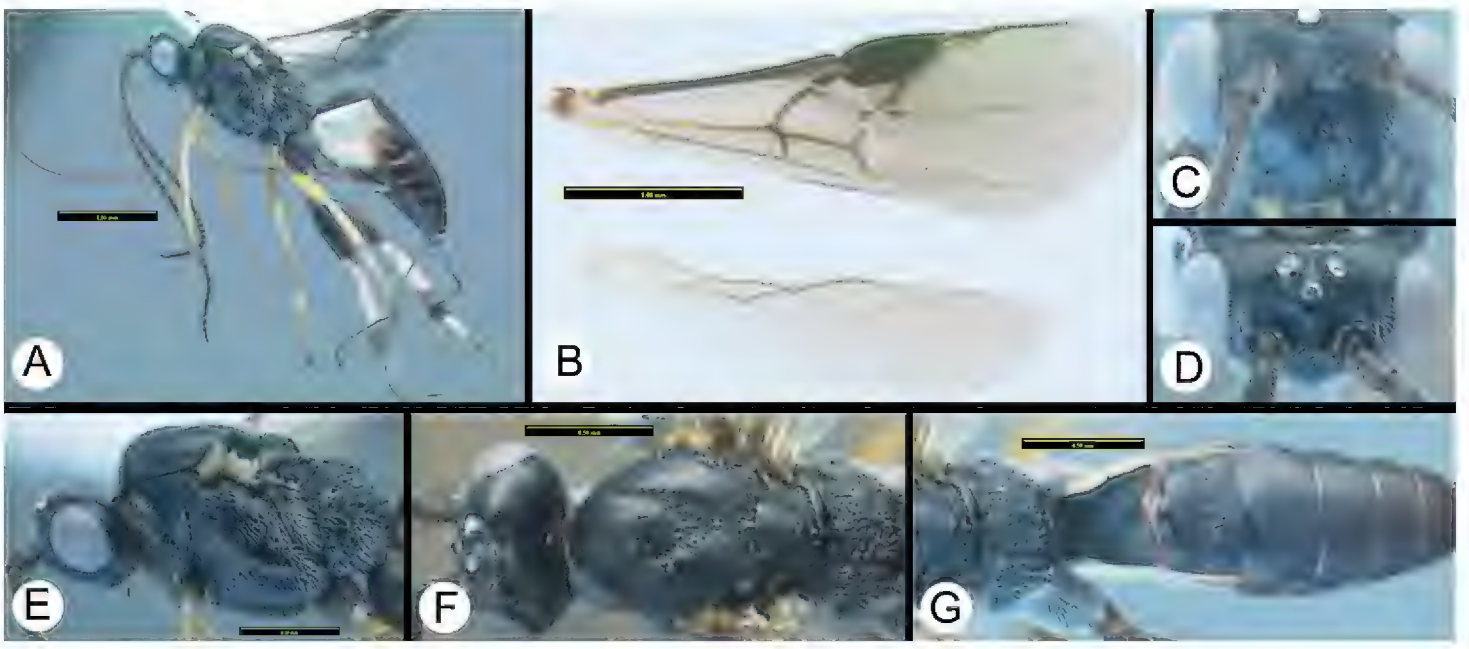


Figure 5. *Therophilus areeluckae* sp. n. **a** lateral habitus **b** Wings **c** anterodorsal head **d** dorsal head **e** lateral head and mesosoma **f** dorsal head and mesosoma **g** dorsal propodeum and Metasoma.

Color. Body mostly melanic, legs mostly pale; body black except as follows: antenna brown, palpi, labrum and other mouthparts yellow; tegula yellow; fore and mid legs yellow except for mostly melanic coxae; hind coxa, trochanter, and femur black; hind tibia mostly pale yellow, melanic apically and with a very weak patch of light brown sub-basally; hind basitarsomere mostly yellow, remaining tarsomeres mostly melanic; anterior metasomal laterotergites and sternites pale yellow; fore wing weakly infuscate. Scape entirely melanic. Tegula yellow, contrasting with predominantly black mesoscutum. Ocellar triangle melanic, concolorous with remainder of vertex. Hind tibia mostly pale, melanic apically and with a subbasal melanic band or lateral spot, or mostly pale, melanic apically only. Fore tarsus mostly or entirely pale. Pronotum entirely melanic. MT2 entirely melanic.

Etymology. Named in honor of Ms. Yuwadee Areeluck, collector for the TIGER project at Doi Inthanon National Park.

Distribution. Distribution map can be found at http://purl.org/thaimap/areeluckae

Material examined. Holotype ♀. H988 [QSBG] Thailand, Chae Son NP, Youthcamp/meeting hall, 476m, 18.831°N, 99.47°E, MT, 22–28.iii.2008. http://purl.org/taxabank/T.areeluckae

***Therophilus boonthami* Sharkey sp. n.**
urn:lsid:zoobank.org:act:EC88E916-3270-4275-8333-362B0535B046
http://species-id.net/wiki/Therophilus_boonthami
Figure 6

Diagnosis. Ocellar triangle melanic, contrasting with remainder of vertex, which is pale. Hind tibia mostly melanic, pale color restricted to extreme base.

Description. Body length. 3.3 mm.

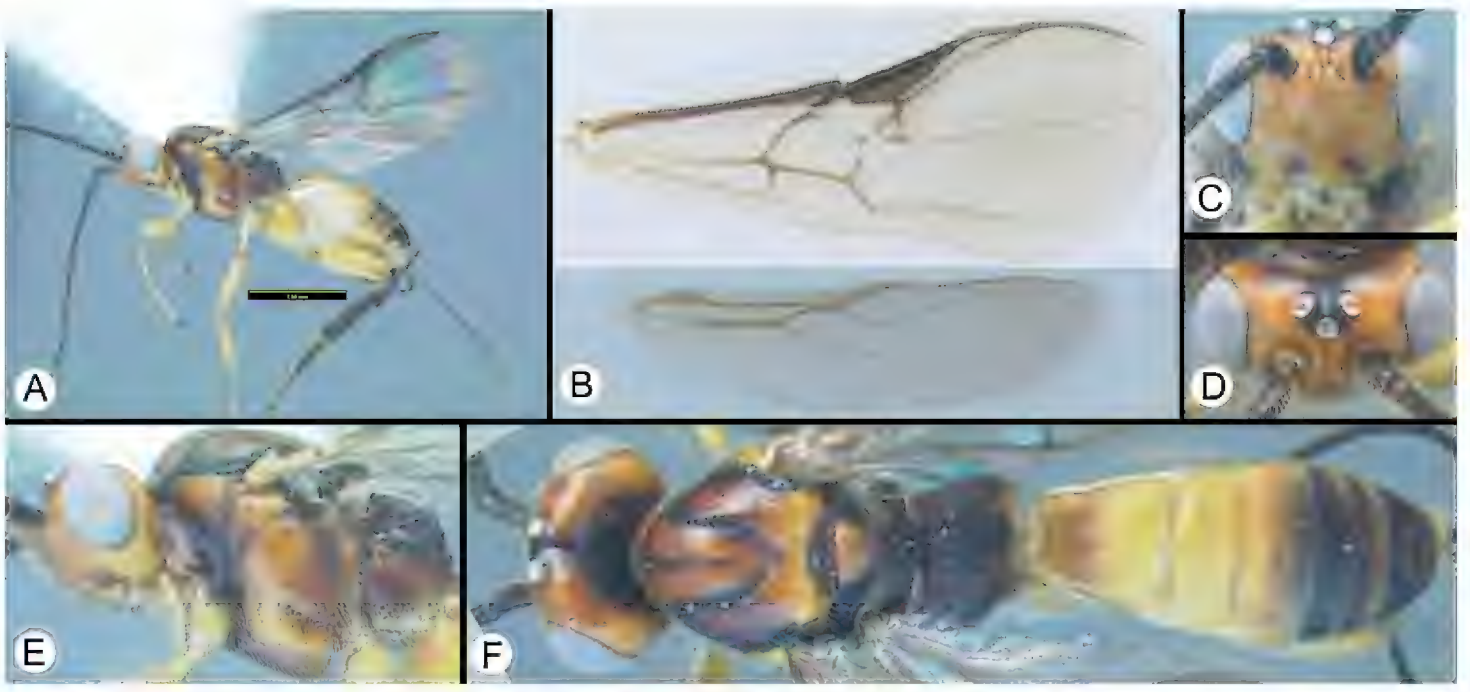


Figure 6. *Therophilus boonthami* sp. n. **a** lateral habitus **b** Wings **c** anterodorsal head **d** dorsal head **e** lateral head and mesosoma **f** dorsal habitus.

Head. Space between antennal insertions with a weakly developed bulge that is weakly declivous posteriorly, dorsal surface of bulge with a shallow longitudinal groove. Number of flagellomeres 28. Posterior surface of scutellum posterior scutellar depression represented by two pits.

Mesosoma. Number of pegs on mid tibia = 5. Number of pegs on hind tibia = 9. Sclerite between metasoma and hind coxa narrow, and lacking a high ridge along its length. Length-width of hind femur 0.755/0.31 = 2.4. 2nd submarginal cell large, cell height subequal to petiole length. Hind wing vein Cub emanates from near anterior apex of apical margin of subbasal cell, Cub long and weak. Notauli meeting but sculpture not extending outside of well-defined grooves.

Metasoma. MT1 length only slightly longer than apical width. MT1 with narrowly-spaced longitudinal striae, with some microsculpture between striae, and lacking two pairs of distinctly stronger striae (carinae). Ratio of widest point of MT1 to narrowest point 0.481/0.338 = 1.4. Length-width ratio of MT1 0.55/0.481 = 1.1. MT2 entirely smooth. Ovipositor clearly shorter than body, about as long as Metasoma.

Color. Mostly yellow or yellow-orange with some brown and black; head yellow or orange except antenna, vertex, and occiput brown; thorax yellow or orange and brown, darker near crenulae and sutures; propodeum mostly dark brown; fore and mid legs yellow; hind leg mostly yellow except most of tibia and tarsus melanic, hind tibial spurs yellow; metasoma mostly yellow; posterior terga mostly brown, MT1 with some weak melanic color on longitudinal striae; fore wing weakly infuscate. Tegula yellow, contrasting with predominantly black mesoscutum, or yellow or orange, similar in color to predominantly orange or yellow mesoscutum. Ocellar triangle melanic, contrasting with remainder of vertex. Hind tibia mostly melanic, pale color, if present, restricted to extreme base. MT2 entirely or almost entirely pale.

Etymology. Named in honor of Mr. Tawatchai Boontham, collector for the TIGER project at Huay Namdung National Park.

Molecular data. H633, GenBank Accession: JQ929201.

Distribution. Distribution map can be found at http://purl.org/thaimap/boonthami

Material examined. Holotype ♀. H633 [QSBG] Thailand, Kaeng Krachan NP, km33/helipad, 735m, 12.836°N, 99.345°E, MT, 18–25.ii.2009. http://purl.org/taxabank/T.boonthami

Therophilus chiangmaiensis Sharkey sp. n.

urn:lsid:zoobank.org:act:14069DD0-B68F-4D92-9058-3C20329DDAA7
http://species-id.net/wiki/Therophilus_chiangmaiensis
Figure 7

Diagnosis. Hind tibia mostly melanic with pale coloration restricted to the medial surface at midlength. Wings relatively deeply infuscate.

Description. Body length. 4.6 mm.

Head. Space between antennal insertions with a weakly developed bulge that is weakly declivous posteriorly, dorsal surface of bulge with a shallow longitudinal groove. Number of flagellomeres 28. Posterior surface of scutellum posterior scutellar depression represented by a deep sculptured semicircular pit.

Mesosoma. Number of pegs on mid tibia = 5. Number of pegs on hind tibia = 9. Sclerite between metasoma and hind coxa narrow with a high ridge along most or all of its length. Length-width of hind femur 1.0/0.351 = 2.9. 2nd submarginal cell large, cell height subequal to petiole length. Hind wing vein Cub emanates from near anterior apex of apical margin of subbasal cell, Cub long and weak. Point of notauli intersection heavily sculptured over a wide area with a median longitudinal ridge. Metapleuron with white setae of moderate density.

Metasoma. MT1 with narrowly-spaced, longitudinal striae, with some microsculpture between striae, and with and two pairs of slightly stronger striae (carinae). MT1 distinctly wider apically than basally. Ratio of widest point of MT1 to narrowest point 0.6/0.357 = 1.7. Length-width ratio of MT1 0.77/0.6 = 1.3. MT2 entirely smooth. Ovipositor much longer than metasoma, about as long as body or longer.

Color. Melanic except as follows: mouthparts mostly yellow; mid and hind tibial spurs yellow; hind tibia with a yellow patch medially at mid length; anterior metasomal laterotergites and sternites mostly pale yellow; fore wing infuscate, more so than other species in this revision. Tegula black, concolorous with mesoscutum. Ocellar triangle melanic, concolorous with remainder of vertex. Hind tibia mostly melanic with pale coloration at midlength at least medially. MT2 entirely melanic.

Etymology. Named after the province in which the type specimen was collected.

Molecular data. H1853, GenBank Accession: JQ929190.

Distribution. Distribution map can be found at http://purl.org/thaimaps/chiangmaiensis.

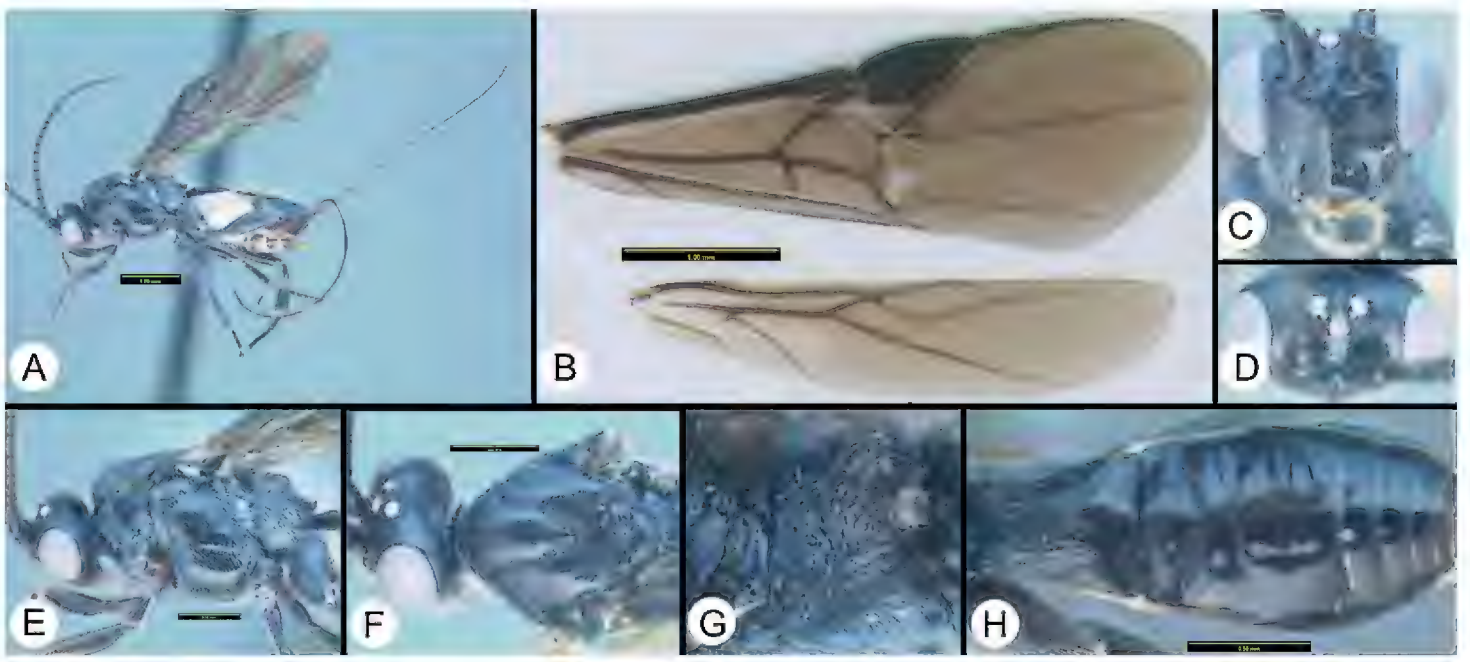


Figure 7. *Therophilus chiangmaiensis* sp. n. **a** lateral habitus **b** Wings **c** anterodorsal head **d** dorsal head **e** lateral head and mesosoma **f** dorsal head and mesosoma **g** dorsal propodeum **h** dorsal Metasoma.

Material examined. Holotype ♀. 1853 [QSBG] Thailand, Chiang Mai, Doi Phahompok NP, Kiewlom1: Montane Forest, 20.0575°N, 99.1425°E, MT 7, 14.viii.2007. http://purl.org/taxabank/T.chiangmaiensis

Therophilus cattienensis van Achterberg & Long

http://species-id.net/wiki/Therophilus_cattienensis

Figure 8

Therophilus cattienensis van Achterberg and Long 2010 [RMNH, type examined] Vietnam.

Diagnosis. Ocellar triangle pale, concolorous with remainder of vertex. Scape at least partly pale, especially anteriorly.

Comments. The Thai specimens differ from the holotype only in the color of the metapleuron which is yellow-brown in the type and melanic in all Thai specimens. This same variation is found in Vietnamese males described by van Achterberg and Long (2010).

Molecular data. H024, GenBank Accession: JQ929199; H050, GenBank Accession: JQ929198; H051, GenBank Accession: JQ929197; H059, GenBank Accession: JQ929196; H401, GenBank Accession, JQ929200.

Distribution. Distribution map can be found at http://purl.org/thaimap/cattienensis

Material examined. ♀. Thailand: Doi Inthanon NP: Vachirathan Fall, 700m, 18.539°N, 98.601°E, MT, 9–16.iii.2007: H0024; 16–23.iii.2007: H0051; 29.iv–6.v.2007: H0058, H0059. H058; Doi Inthanon NP: Kew Maepan Trail, 2200m, 18.553°N, 98.48°E, MT, 29.iv-6.v.2007: H0050. Namtok Mae Surin NP, 19.344°N, 97.988°E, MT, 4–11.v.2008: H0318, H0325, H0329, H0330, H0338, H2427, H2429, H2433, H0471; 19.344°N, 97.988°E, 27.iv–4.v.2008: H0401, H0482;

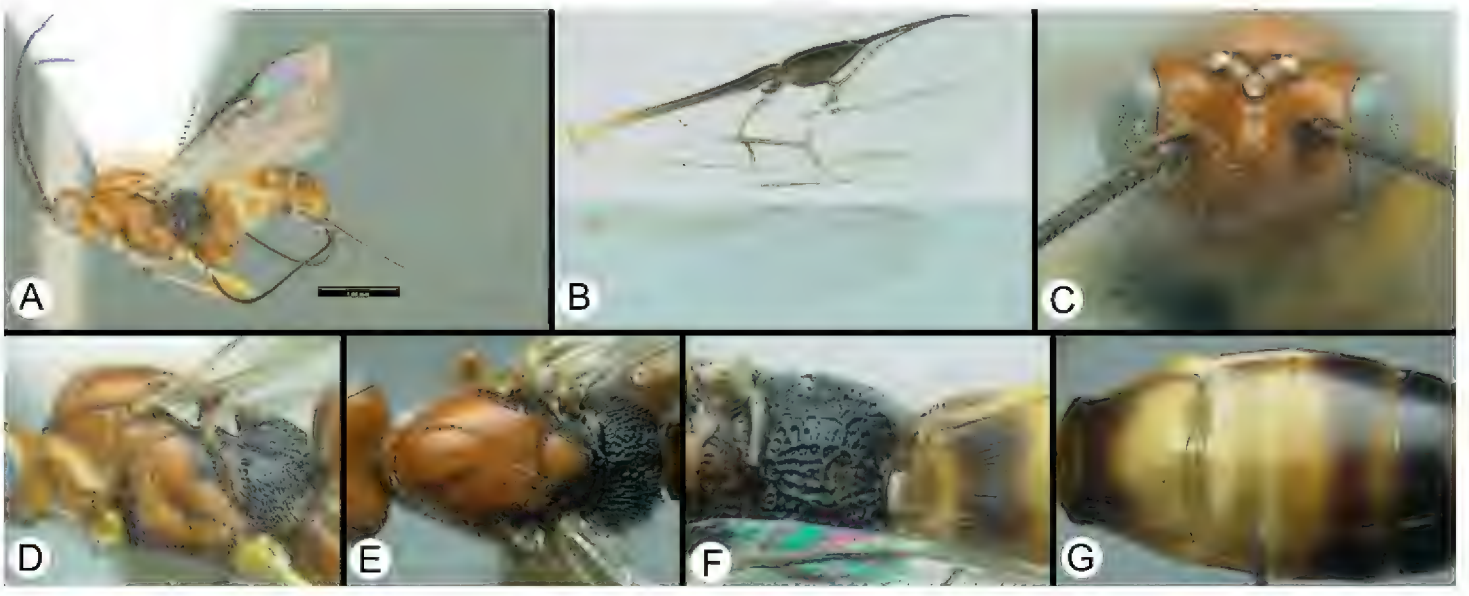


Figure 8. *Therophilus cattienensis* van Achterberg and Long **a** lateral habitus **b** Wings **c** anterodorsal head **d** lateral mesosoma **e** dorsal mesosoma **f** dorsal propodeum **g** MT1–MT4.

19.348°N, 97.985°E, 27.iv-4.v.2008: H0482; 18–25.v.2008: H0435; 19.3482°N, 97.9835°E, H3828, H5514. Doi Chiangdao NP,Headquarter, 19.4046°N, 98.9218°E, MT: H5533. Phu Ruea NP, Pah Lo Noy, 1343m, 17.508°N, 101.348°E, MT, 19–26.ix.2006: H5931, H5933. Khao Sok NP, Headquarter, 115m, 8.915°N, 98.53°E, MT, 25.xi–2.xii.2008: H0319. Chiang Mai Province, Pa Huay Kho, 20–30.vi.1997: H1120. Depository: H1120, H051, H3828, H059, H5533, H050, H024, H401, H5514, H325, H319, H338, H329, H318, H330, H058 [QSBG]; H5933, H5931, H482, H2429, H471, H435, H2427, H2433, H5535 [HIC]. http://purl.org/taxabank/T.cattienensis

Therophilus crenulisulcatus van Achterberg & Long

http://species-id.net/wiki/Therophilus_crenulisulcatus

Figure 9

Therophilus crenulisulcatus van Achterberg and Long 2010 [RMNH, type examined] Vietnam.

Diagnosis. Tegula black, concolorous with mesoscutum. 2nd submarginal cell height subequal to petiole length. Hind tibia mostly pale, melanic apically and with a subbasal melanic band or lateral spot. Pronotum entirely melanic. MT2 with weak short longitudinal striae restricted to transverse depression, or entirely smooth.

Comments. The Thai specimen has a slightly longer ovipositor, otherwise very similar to type.

Distribution. Distribution map can be found at http://purl.org/thaimap/crenulisulcatus

Material examined. ♀. 8481 [QSBG] Thailand, Doi Phahompok NP, Kiewlom1: Montane Forest, 20.0575°N 99.1425°E, MT, 7-14.viii.2007. http://purl.org/taxabank/T.crenulisulcatus

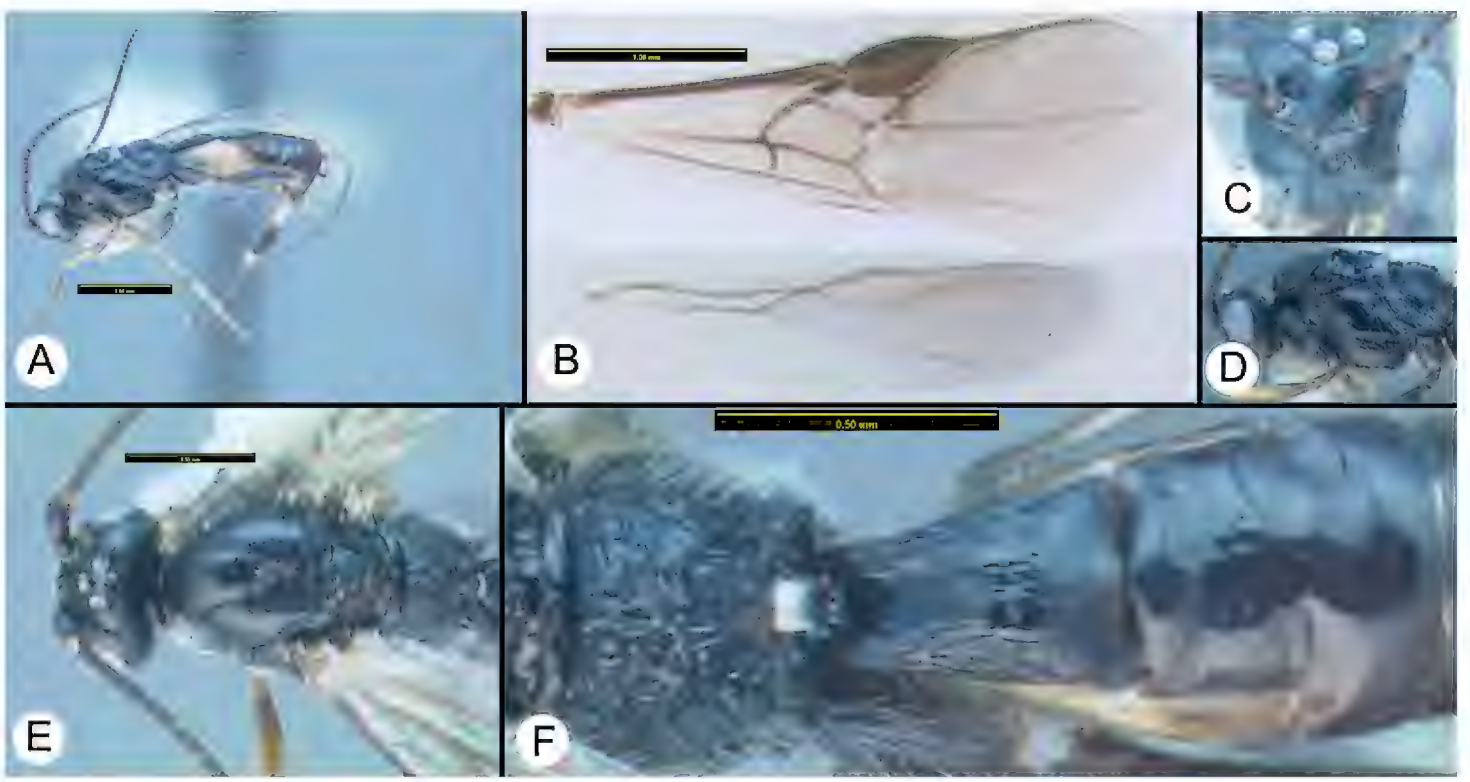


Figure 9. *Therophilus crenulisulcatus* van Achterberg & Long **a** lateral habitus **b** Wings **c** anterodorsal head **d** lateral head and mesosoma **e** dorsal head and mesosoma **f** dorsal propodeum and MT1–3

***Therophilus kwanuiae* Sharkey sp. n.**
urn:lsid:zoobank.org:act:559CE2A4-FCE2-4EBA-A413-EF983FF0AC1B
http://species-id.net/wiki/Therophilus_kwanuiae
Figure 10

Diagnosis. 2nd submarginal cell reduced to a small dot, petiole longer than cell is high. Tegula black, concolorous with mesoscutum. Fore tarsus entirely pale.

Description. Body length. 3.8 mm.

Head. Space between antennal insertions with a weakly developed bulge that is weakly declivous posteriorly, dorsal surface of bulge with a shallow longitudinal groove. Number of flagellomeres 29. Posterior surface of scutellum posterior scutellar depression represented by several (2–3) pits.

Mesosoma. Number of pegs on mid tibia = 5. Number of pegs on hind tibia = 8. Sclerite between metasoma and hind coxa narrow with a high ridge along most or all of its length. Length-width of hind femur 0.911/0.292 = 3.1. 2nd submarginal cell reduced to a small dot, petiole longer than cell is high. Hind wing vein Cub emanates from near anterior apex of apical margin of subbasal cell, Cub short and weak. Notauli meeting but sculpture not extending much outside of well-defined grooves.

Metasoma. MT1 length distinctly longer than apical width. MT1 with narrowly-spaced, longitudinal striae, with some microsculpture between striae, and with and two pairs of slightly stronger striae (carinae). MT1 distinctly wider apically than ba-

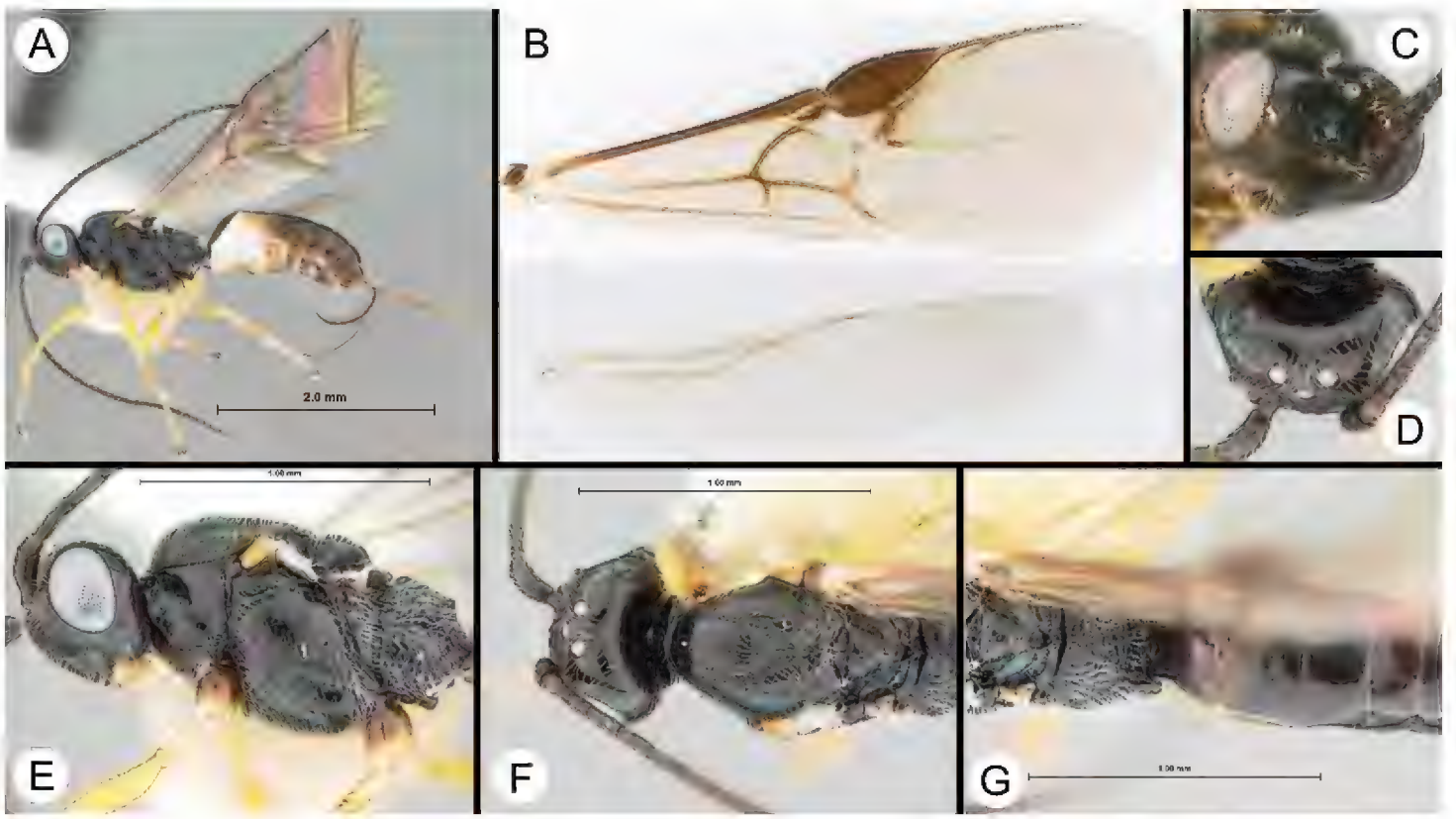


Figure 10. *Therophilus kwanuiae* n. sp. **a** lateral habitus **b** wings **c** dorsolateral head **d** dorsal head **e** lateral head and mesosoma **f** dorsal head and mesosoma **g** dorsal propodeum and metasomal terga 1–3.

sally. Ratio of widest point of MT1 to narrowest point 0.475/0.3 = 1.6. Length-width ratio of MT1 0.695/0.475 = 1.5. MT2 entirely smooth. Ovipositor much longer than metasoma, about as long as body or longer.

Color. Mostly melanic except as follows: mouthparts yellow except galea melanic; fore and mid legs yellow except coxae, trochanters and base of femora melanic; hind tibia mostly pale, melanic in apical third with a pale, tan, lateral, spot near base; anterior metasomal laterotergites and sternites mostly pale yellow; fore wing weakly infuscate. Tegula black, concolorous with mesoscutum. Ocellar triangle melanic, concolorous with remainder of vertex. Hind tibia mostly pale, melanic apically and with a subbasal melanic band or lateral spot, or mostly pale, melanic apically only. Fore tarsus mostly or entirely pale. MT2 entirely melanic.

Etymology. Named in honor of Ms. Boonruen Kwanui, collector for the TIGER project at Chae Son National Park

Distribution. Distribution map can be found at http://purl.org/thaimap/kwanuiae

Material examined. Holotype ♀. H927 [QSBG] Thailand, Huai Nam Dang NP, Visitor center, 19.313°N, 98.607°E, MT, 31.iii–7.iv.2008.

Paratype ♀. H5524 [QSBG] Thailand, Chiang Mai , Huai Nam Dang NP, Thung Buatong View Point , 19.2926°N, 98.6004°E, MT, 7–13.ii.2008 http://purl.org/taxabank/T.kwanuiae

Therophilus planifrons van Achterberg & Long

http://species-id.net/wiki/Therophilus_planifrons

Figure 11

Therophilus planifrons van Achterberg and Long 2010 [RMNH, type examined] Vietnam.

Diagnosis. Ovipositor clearly shorter than body, about as long as Metasoma. Hind tibia mostly pale, melanic apically and with a subbasal melanic band or lateral spot.

Molecular data. H235, GenBank Accession: JQ929182.

Distribution. Distribution map can be found at http://purl.org/thaimap/planifrons

Material examined. ♀. H235 [QSBG] Thailand, Huai Nam Dang NP, behind visitor house, 1670m, 19.312°N, 98.607°E, MT, 31.vii–7.viii.2007. http://purl.org/taxabank/T.planifrons

Therophilus songrani Sharkey sp. n.

urn:lsid:zoobank.org:act:10BACCAA-3356-4484-B8AA-138F5BA8D516

http://species-id.net/wiki/Therophilus_songrani

Figure 12

Diagnosis. Ocellar triangle pale, concolorous with remainder of vertex. Tegula yellow or orange, similar in color to predominantly orange or yellow mesoscutum. MT1 distinctly longer than apical width.

Description. Body length. 3.5 mm.

Head. Space between antennal insertions with a weakly developed bulge that is weakly declivous posteriorly, dorsal surface of bulge with a shallow longitudinal groove. Number of flagellomeres 29. Posterior surface of scutellum posterior scutellar depression represented by two pits.

Mesosoma. Number of pegs on mid tibia = 6. Number of pegs on hind tibia = 10. Sclerite between metasoma and hind coxa narrow, and lacking a high ridge along its length. Length-width of hind femur 0.750/0.265 = 2.8. 2nd submarginal cell large, cell height subequal to petiole length. Hind wing vein Cub emanates from near anterior apex of apical margin of subbasal cell, Cub long and weak. Notauli barely meeting and sculpture not extending past meeting point.

Metasoma. MT1 length distinctly longer than apical width. MT1 with narrowly-spaced longitudinal striae, with some microsculpture between striae, and lacking two pairs of distinctly stronger striae (carinae). MT1 distinctly wider apically than basally. Ratio of widest point of MT1 to narrowest point 0.367/0.264 = 1.5. Length-width ratio of MT1 0.54/0.387 = 1.4. MT2 with transverse and/or diagonal striae in and/or near transverse depression. Ovipositor much longer than metasoma, about as long as body or longer.

Color. Yellow or yellow-orange except as follows: antenna melanic; thorax with melanic infusions along crenulae and sutures; propodeum mostly melanic; MT3-MT7

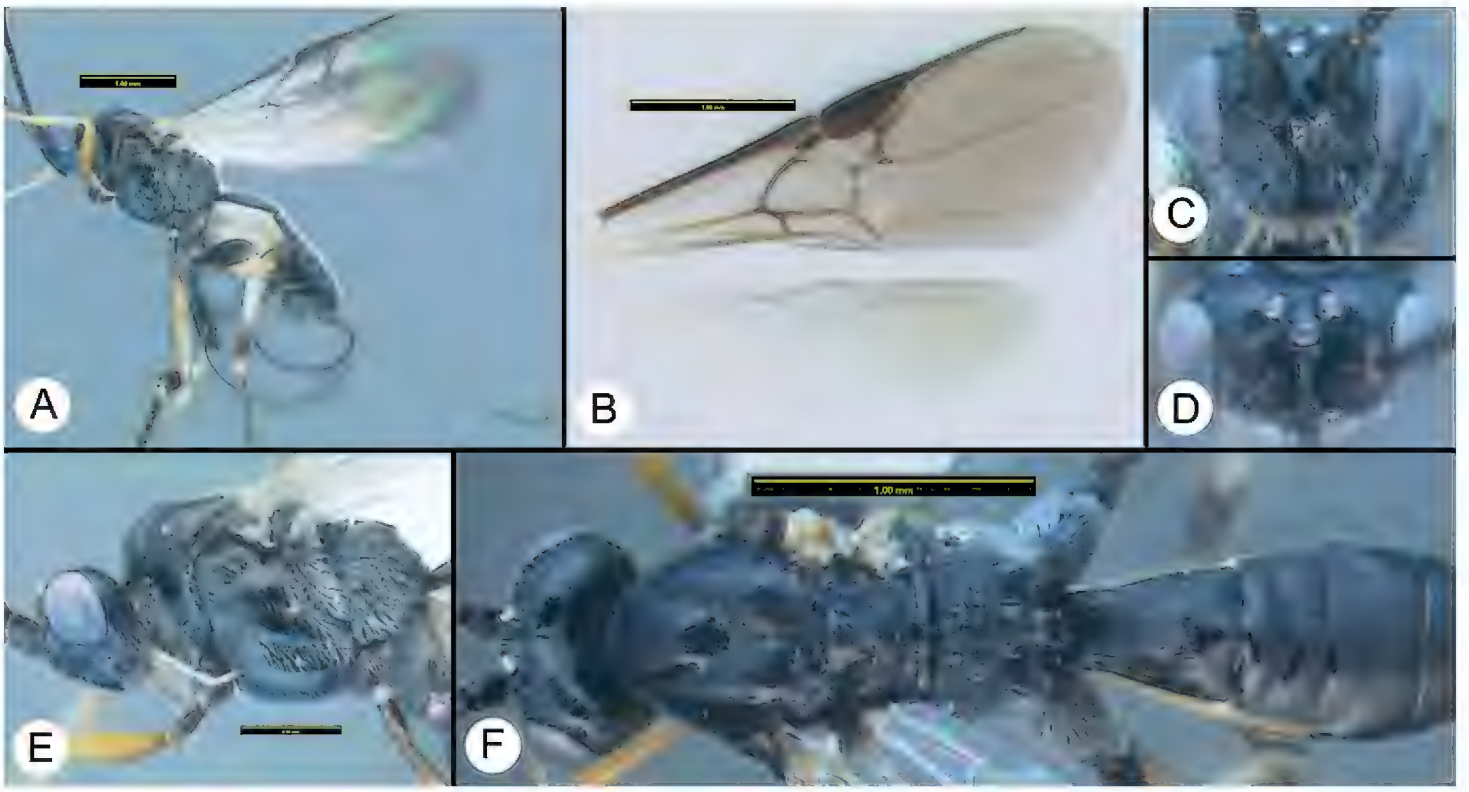


Figure 11. *Therophilus planifrons* van Achterberg & Long. **a** lateral habitus **b** Wings **c** dorsolateral head **d** dorsal head **e** lateral head and mesosoma **f** dorsal head and mesosoma **g** dorsal propodeum and MT1–MT3.

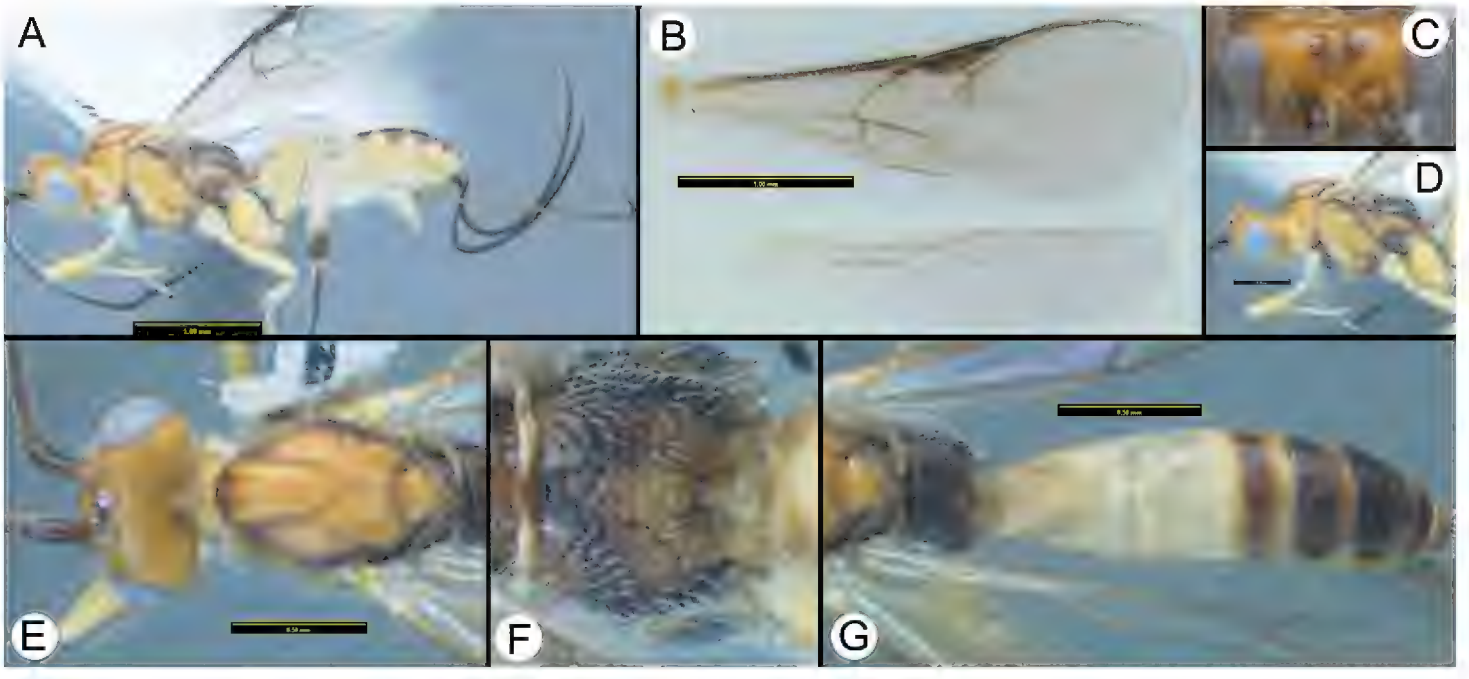


Figure 12. *Therophilus songrani* sp. n. **a** lateral habitus **b** Wings **c** dorsal head **d** lateral head and mesosoma **e** dorsal head and mesosoma **f** dorsal propodeum **g** dorsal propodeum and Metasoma.

mostly brown; Wings hyaline. Scape entirely melanic. Tegula yellow or orange, similar in color to predominantly orange or yellow mesoscutum. Ocellar triangle pale, concolorous with remainder of vertex. Hind tibia mostly pale, melanic apically only. MT2 entirely or almost entirely pale.

Etymology. Named in honor of Mr. Songran Chaksu, collector for the TIGER project at Doi Chiangdao Wildlife Sanctuary.

Molecular data. H352, GenBank Accession: JQ929192.

Distribution. Distribution map can be found at http://purl.org/thaimap/songrani

Material examined. Holotype ♀. H352 [QSBG] Thailand, Queen Sirikit Botanic Garden, 811m, 18.881°N, 98.862°E, MT, 30.iv–12.v.2009. http://purl.org/taxabank/T.songrani

Therophilus sukpengae Sharkey sp. n.

urn:lsid:zoobank.org:act:F2A17DCC-B414-44FB-80B8-5B1360C28707
http://species-id.net/wiki/Therophilus_sukpengae
Figure 13

Diagnosis. MT2 smooth in most of anterior half anteriad transverse groove, longitudinally striate in transverse groove and area posteriad transverse groove, at least medially. Tegula black, concolorous with mesoscutum.

Description. Body length. 3.9 mm.

Head. Space between antennal insertions with a weakly developed bulge that is weakly declivous posteriorly, dorsal surface of bulge with a shallow longitudinal groove. Number of flagellomeres 27. Posterior surface of scutellum posterior scutellar depression represented by two pits.

Mesosoma. Number of pegs on mid tibia = 4. Number of pegs on hind tibia = 9. Sclerite between metasoma and hind coxa narrow with a high ridge along most or all of its length. Length-width of hind femur 0.8/0.266 = 3.0. 2nd submarginal cell large, cell height subequal to petiole length. Hind wing vein Cub emanates from near anterior apex of apical margin of subbasal cell, Cub long and weak. Point of notauli intersection heavily sculptured over a wide area.

Metasoma. MT1 length distinctly longer than apical width. MT1 with narrowly-spaced longitudinal striae, with some microsculpture between striae, and lacking one pair of distinctly stronger striae (carinae). MT1 distinctly wider apically than basally. Ratio of widest point of MT1 to narrowest point 0.383/0.263 = 1.5. Length-width ratio of MT1 0.61/0.383 = 1.6. MT2 smooth in most of anterior half anteriad transverse groove, longitudinally striate in transverse groove and area posteriad transverse groove, at least medially. Ovipositor much longer than metasoma, about as long as body or longer.

Color. Body mostly melanic, legs mostly pale; body melanic except as follows: mouthparts yellow, tegula brown, fore and mid legs mostly yellow except coxae melanic, basal half of femora brown and apex of tibiae and some tarsomeres light brown, hind tibia mostly pale except apex and a light brown subbasal lateral spot, all tibial spurs yellow; anterior metasomal laterotergites and sternites pale yellow; fore wing weakly infuscate. Tegula black, concolorous with mesoscutum. Ocellar triangle melanic, concolorous with remainder of vertex. Hind tibia mostly pale, melanic apically and with a subbasal melanic band or lateral spot. Pronotum entirely melanic. MT2 entirely melanic.

Etymology. Named in honor of Ms. Acharaporn Sukpeng collector for the TIGER project at Chae Son National Park.

Distribution. Distribution map can be found at http://purl.org/thaimap/sukpengae

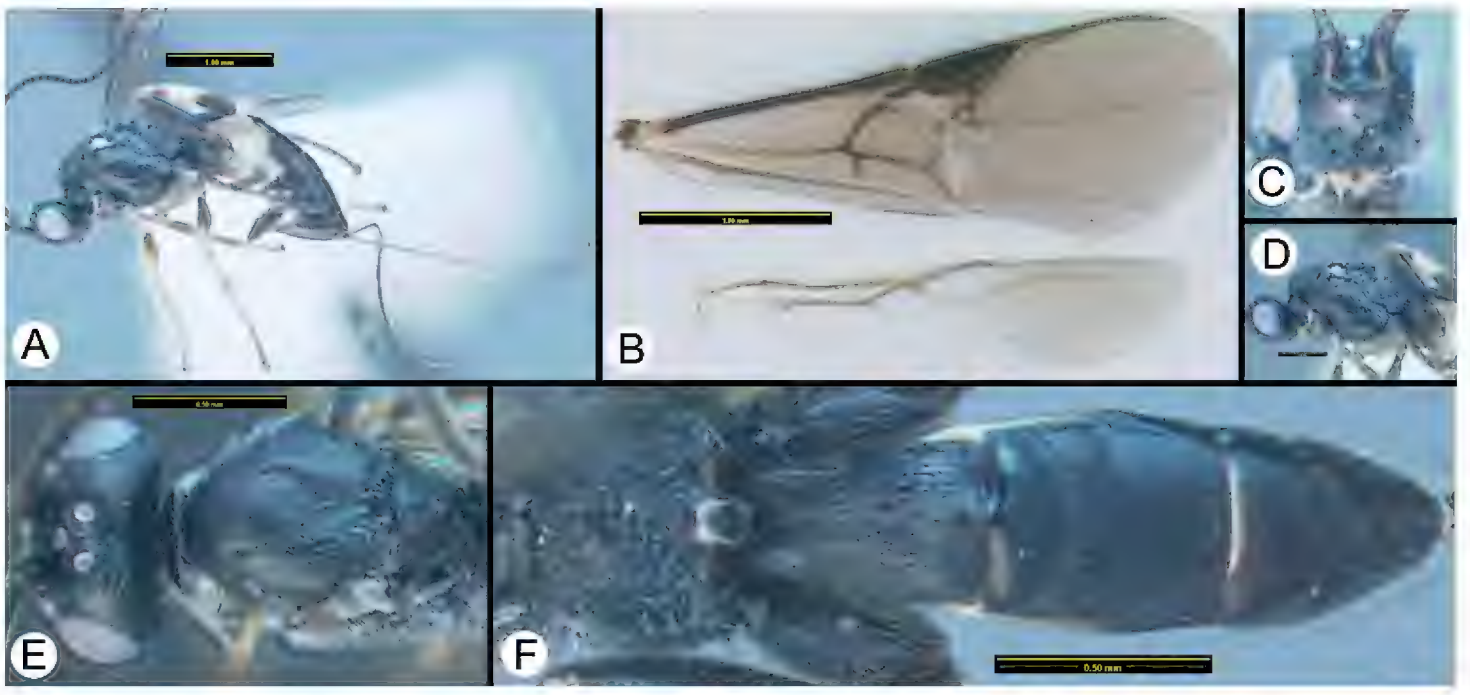


Figure 13. *Therophilus sukpengae* sp. n. **a** lateral habitus **b** Wings **c** anterior head **d** lateral head and mesosoma **e** dorsal head and mesosoma **f** dorsal propodeum and Metasoma.

Material examined. Holotype ♀. H998 [QSBG] Thailand Pu Toei NP, Protection unit2/Pu Krathing, 220m, 14.803°N, 99.416°E, MT, 1–7.v.2009. http://purl.org/taxabank/T.sukpengae

***Therophilus wannai* Sharkey sp. n.**
urn:lsid:zoobank.org:act:8E959BFE-D614-4100-8123-89A95E0FF0B1
http://species-id.net/wiki/Therophilus_wannai
Figure 14

Diagnosis. MT2 with short longitudinal striae restricted to transverse depression. Mid femur mostly melanic, pale apically. Fore tarsus mostly pale, melanic basally. Pronotum mostly melanic but with a pale spot dorsomedially.

Description. Body length. 3.8 mm.

Head. Space between antennal insertions with a weakly developed bulge that is weakly declivous posteriorly, dorsal surface of bulge with a shallow longitudinal groove. Number of flagellomeres 28. Posterior surface of scutellum posterior scutellar depression represented by several pits forming a semicircular area.

Mesosoma. Number of pegs on mid tibia = 6. Number of pegs on hind tibia = 8. Sclerite between metasoma and hind coxa narrow with a high ridge along most or all of its length. Length-width of hind femur 0.823/0.256 = 3.2. 2nd submarginal cell large, cell height subequal to petiole length. Hind wing vein Cub emanates from near anterior apex of apical margin of subbasal cell, Cub short and weak. Notauli extending past meeting point but sculpture not extending over a wide area.

Metasoma. MT1 length distinctly longer than apical width. MT1 with narrowly-spaced longitudinal striae, with some microsculpture between striae, and lacking two

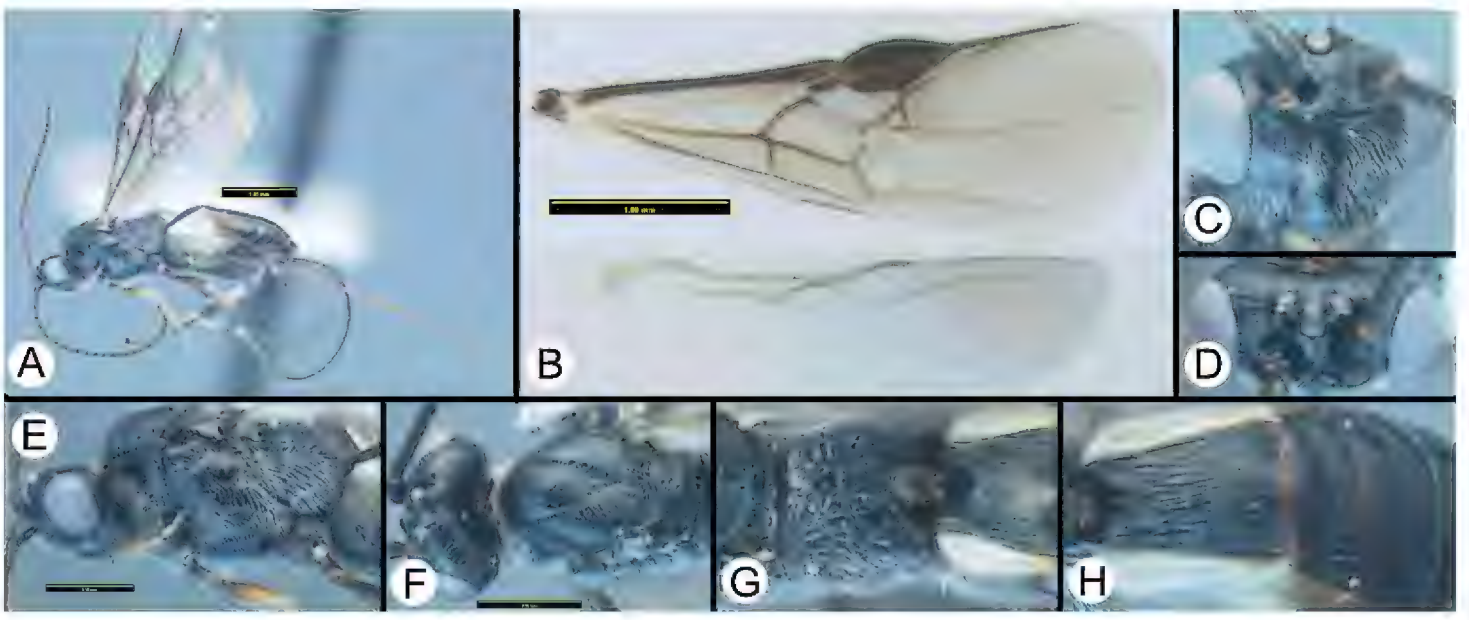


Figure 14. *Therophilus wannai* sp. n. **a** lateral habitus **b** Wings **c** anterior head **d** dorsal head **e** lateral head and mesosoma **f** dorsal head and mesosoma **g** dorsal propodeum **h** dorsal MT1–MT3.

pairs of distinctly stronger striae (carinae). MT1 distinctly wider apically than basally. Ratio of widest point of MT1 to narrowest point 0.437/0.281 = 1.6. Length-width ratio of MT1 0.702/0.437 = 1.6. MT2 with short longitudinal striae restricted to transverse depression. Ovipositor much longer than metasoma, about as long as body or longer.

Color. Melanic except as follows: mouthparts mostly yellow; fore and mid femora and tibiae yellow-brown, mid leg noticeably darker than fore leg; hind tibia yellow at mid length and basally, melanic apically and subbasally; anterior metasomal laterotergites and sternites pale yellow; fore wing weakly infuscate. Tegula black, concolorous with mesoscutum. Ocellar triangle melanic, concolorous with remainder of vertex. Hind tibia mostly pale, melanic apically and with a subbasal melanic band or lateral spot. Fore tarsus mostly or entirely pale. Pronotum mostly melanic but pale dorsomedially. MT2 entirely melanic.

Etymology. Named in honor of Mr. Charoen Wanna, collector for the TIGER project at Doi Phuka National Park.

Distribution. Distribution map can be found at http://purl.org/thaimap/wannai

Material examined. Holotype ♀. H345 [QSBG] Thailand Doi Phu Kha NP, Office 11, 1359m, 19.208°N, 101.081°E, MT, 15–22.xi.2007. http://purl.org/taxabank/T.wannai

***Therophilus wongchaii* Sharkey sp. n.**
urn:lsid:zoobank.org:act:727FD2FF-CCCD-4090-930D-7DF23FDF71BB
http://species-id.net/wiki/Therophilus_wongchaii
Figure 15

Diagnosis. Ocellar triangle melanic, contrasting with remainder of vertex, or pale, concolorous with remainder of vertex. Tegula yellow, contrasting with black lateral

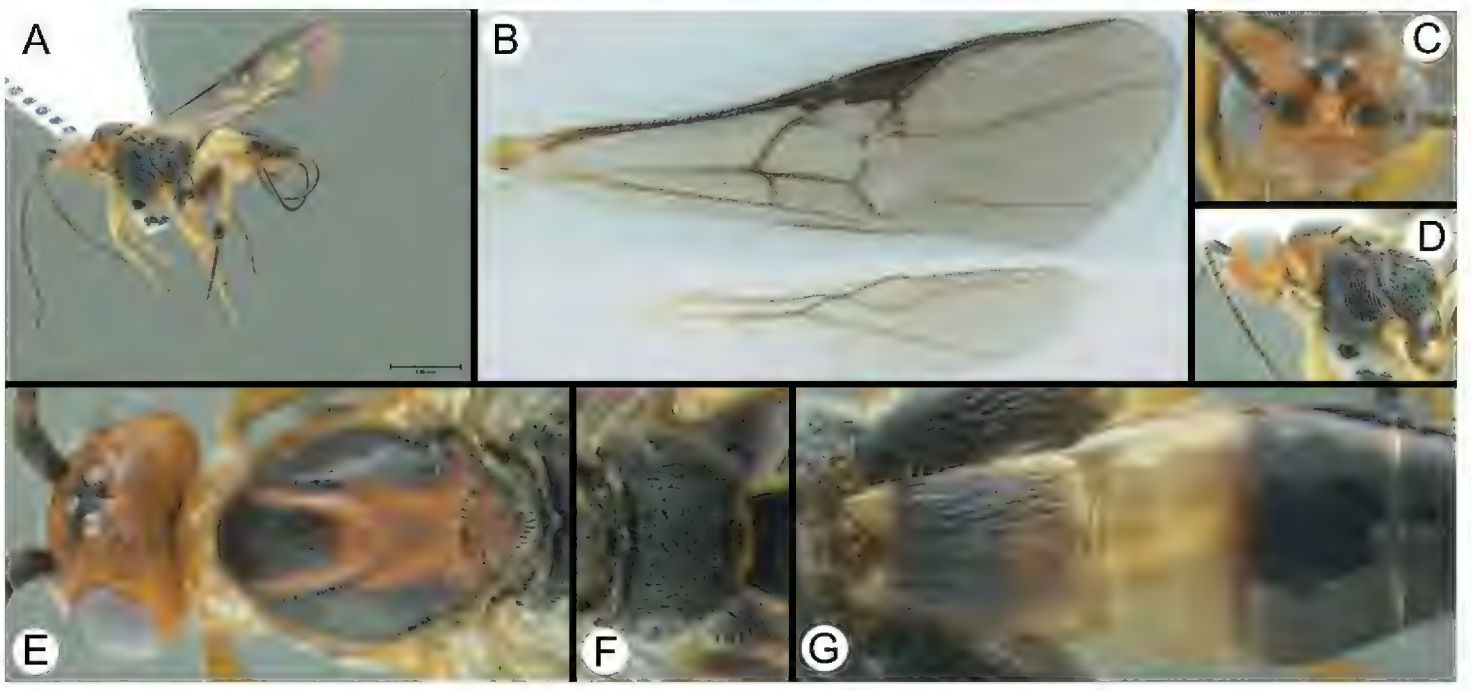


Figure 15. *Therophilus wongchaii* sp. n. **a** lateral habitus **b** Wings **c** anterodorsal head **d** later head and mesosoma **e** dorsal head and mesosoma **f** dorsal propodeum **g** dorsal MT1–MT3.

lobes of mesoscutum. Hind tibia largely pale, melanic apically and with a subbasal melanic band or lateral spot, or mostly pale, melanic apically only.

Description. Body length. 3.5 mm.

Head. Space between antennal insertions with a weakly developed bulge that is weakly declivous posteriorly, dorsal surface of bulge with a shallow longitudinal groove. Number of flagellomeres 29. Posterior surface of scutellum posterior scutellar depression represented by two pits.

Mesosoma. Number of pegs on mid tibia = 5. Number of pegs on hind tibia = 9. Sclerite between metasoma and hind coxa narrow, and lacking a high ridge along its length. Length-width of hind femur 0.850/0.298 = 2.9. 2nd submarginal cell large, cell height subequal to petiole length. Hind wing vein Cub emanates from near anterior apex of apical margin of subbasal cell, Cub long and weak. Notauli extending past meeting point but sculpture not extending over a wide area.

Metasoma. MT1 length distinctly longer than apical width. MT1 with narrowly-spaced longitudinal striae, with some microsculpture between striae, and lacking two pairs of distinctly stronger striae (carinae). MT1 not distinctly wider apically than basally. Ratio of widest point of MT1 to narrowest point 0.4/0.311 = 1.3. Length-width ratio of MT1 0.642/0.4 = 1.6. MT2 with transverse and/or diagonal striae in and/or near transverse depression. Ovipositor much longer than metasoma, about as long as body or longer.

Color. Orange, yellow, black, and brown; head mostly orange, ocellar triangle melanic; antenna melanic; mesoscutum mostly pale medially, melanic laterally; prothorax yellow; meso and metapleuron and propodeum melanic; fore and mid legs yellow; hind leg brown except trochanter and most of tibia yellow; metasomal mediotergites mostly melanic except base of MT1 and all of MT2 yellow; anterior metasomal laterotergites and sternites pale yellow, remainder of metasoma melanic; fore wing weakly

infuscate. Scape entirely melanic. Tegula yellow, contrasting with predominantly black mesoscutum. Ocellar triangle melanic, contrasting with remainder of vertex, or pale, concolorous with remainder of vertex. Hind tibia mostly pale, melanic apically and with a subbasal melanic band or lateral spot, or mostly pale, melanic apically only. Fore tarsus mostly or entirely pale. MT2 entirely melanic, or pale in anterior half, melanic posteriorly, or entirely or almost entirely pale.

Etymology. Named in honor of Mr. Prasit Wongchai, collector for the TIGER project at Doi Phahompok National Park.

Molecular data. H314, GenBank Accession: JQ929194; H977, GenBank Accession: JQ929195; H661, GenBank Accession: JQ929193.

Distribution. Distribution map can be found at http://purl.org/thaimap/wongchaii

Material examined. Holotype ♀. H314 [QSBG] Thailand, Kaeng Krachan NP,km33/helipad, 735m, 12.836°N, 99.345°E, MT, 7–14.xi.2008.

Paratypes ♀. Thailand: Kaeng Krachan NP: km33/helipad, 735m, 12.836°N, 99.345°E, MT, 11–18.v.2009: H977; 24.iv–4.v.2009: H661; 17–24.iv.2009: H476; 17–24.iv.2009: H476; 4–11.v.2009: H565, H563; 31.x–7.xi.2008: H604; Pa La-U/ waterfall/car park1, 12.536°N, 99.4722°E, pan trap, 2–3.v.2009: H303; 12.536°N, 99.468°E, MT, 4–11.xii.2008: H2439; Panernthung/km30 old lavatory, 970m, 12.825°N, 99.365°E, MT, 11–18.vii.2008: H2404. Depository: H977, H661, H476, H565, H604, [QSBG]; H303, H563, H2439, H2404 [HIC].

http://purl.org/taxabank/T.wongchaii

Therophilus wongwani **Sharkey sp. n.**
urn:lsid:zoobank.org:act:0494CCB9-5FB4-43E1-B807-7E434F43761B
http://species-id.net/wiki/Therophilus_wongwani
Figure 16

Diagnosis. 2nd submarginal cell reduced to a small dot, petiole longer than cell is high. Tegula black, concolorous with mesoscutum. Fore tarsus mostly melanic with some pale color apically. Exposed portion of ovipositor distinctly longer than body.

Description. Body length. 4.4 mm.

Head. Space between antennal insertions with a weakly developed bulge that is weakly declivous posteriorly, dorsal surface of bulge with a shallow longitudinal groove. Number of flagellomeres 27. Posterior surface of scutellum completely rugose, posterior scutellar depression not distinct.

Mesosoma. Number of pegs on mid tibia = 8. Number of pegs on hind tibia = 11. Sclerite between metasoma and hind coxa narrow with a high ridge along most or all of its length. Length-width of hind femur 0.854/0.263 = 3.3. 2nd submarginal cell reduced to a small dot, petiole longer than cell is high. Hind wing vein Cub emanates from near mid length of apical margin of subbasal cell, Cub long and strong. Notauli extending past meeting point but sculpture not extending over a wide area.

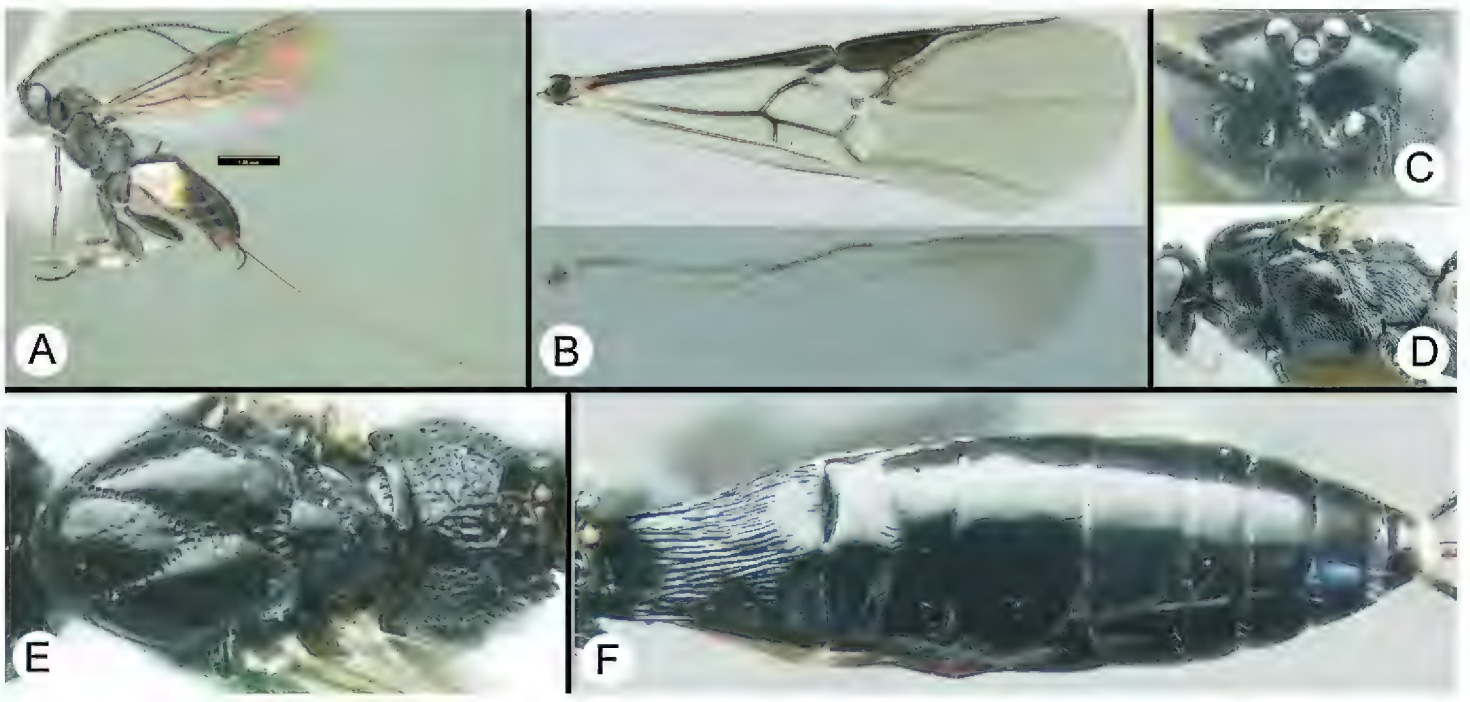


Figure 16. *Therophilus wongwani* sp. n. **a** lateral habitus **b** Wings **c** anterodorsal head **d** lateral head and mesosoma **e** dorsal mesosoma and propodeum **f** dorsal Metasoma.

Metasoma. MT1 length distinctly longer than apical width. MT1 with narrowly-spaced longitudinal striae, with some microsculpture between striae, and lacking two pairs of distinctly stronger striae (carinae). MT1 distinctly wider apically than basally. Ratio of widest point of MT1 to narrowest point 0.533/0.290 = 1.8. Length-width ratio of MT1 0.717/0.533 = 1.4. MT2 with short longitudinal striae restricted to transverse depression. Ovipositor much longer than metasoma, about as long as body or longer. Ovipositor length exposed portion of ovipositor distinctly longer than body.

Color. Black except as follows; mouthparts mostly yellow; hind tibia pale yellow except black at apex and subapically; anterior metasomal laterotergites and sternites pale yellow; fore wing weakly infuscate. Tegula black, concolorous with mesoscutum. Ocellar triangle melanic, concolorous with remainder of vertex. Hind tibia mostly pale, melanic apically and with a subbasal melanic band or lateral spot. Fore tarsus mostly or entirely melanic. MT2 entirely melanic.

Etymology. Named in honor of Mr. Nikom Wongwan, collector for the TIGER project at Doi Phuka National Park.

Molecular data. H028, GenBank Accession: JQ29188; H029, GenBank Accession: HQ929189; H047, GenBank: JQ929186; H048, GenBank Accession: JQ929187; H066, GenBank Accession: JQ929185; H1854, GenBank Accession: JQ929191.

Distribution. Distribution map can be found at http://purl.org/thaimap/wongwani

Material examined. Holotype ♀. H028 [QSBG] Thailand, Doi Inthanon NP, Summit marsh, 2500m, 18.589°N, 98.486°E, MT, 23.iii–1.v.2007.

Paratypes ♀. Doi Inthanon NP, Summit marsh, 2500m, 18.589°N 98.486°E, MT, 8-15.v.2007: H5925, H5926, H5929, H8479, H8480, H066; 23.iii-1.v.2007:

H029; 17-24.xi.2006: H048; 22-29.iv.2007: H047; 1-8.xii.2006: H285; 5-12.i.2007: H5934; 2-10.xi.2006: H1854; Doi Chiangdao NP, water reservoir, 549m, 19.407°N 98.921°E, MT, 18-25.ix.2007: H978, H5510; Doi Phahompok NP,Kiewlom2/ Montane Forest 20.0571°N 99.1425°E: H3803. Depository: H5926, H066, H048, H5510, H285, H5929, H5934 [QSBG]; H029, H5925, H8480, H8479, H978, H1854, H047, H3803 [HIC] http://purl.org/taxabank/T.wongwani

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Appendix 1

DELTA data matrix, images, and other files to the dichotomous key for Therophilus s.s. (Hymenoptera: Braconidae: Agathidinae) from Thailand. doi: 10.3897/JHR.27.2832.app1

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Citation: Sharkey MJ, Stoelb SAC (2012) Revision of Therophilus s.s. (Hymenoptera, Braconidae, Agathidinae) from Thailand. Journal of Hymenoptera Research 27: 1–36. doi: 10.3897/JHR.27.2832.app1

Appendix 2

DELTA data matrix, images, and other files to species descriptions for Therophilus s.s. (Hymenoptera, Braconidae, Agathidinae) from Thailand. doi: 10.3897/JHR.27.2832.app2

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Citation: Sharkey MJ, Stoelb SAC (2012) Revision of Therophilus s.s. (Hymenoptera, Braconidae, Agathidinae) from Thailand. Journal of Hymenoptera Research 27: 1–36. doi: 10.3897/JHR.27.2832.app2

Appendix 3

Interactive key, in IntKey format, to Therophilus s.s. (Hymenoptera, Braconidae, Agathidinae) from Thailand. doi: 10.3897/JHR.27.2832.app3

Explanation note: To run the identification key, you will need Windows 95/NT or a later version.

You also need to download Intkey software and reboot your computer, if it is not already installed. The software package, Intkey, can be downloaded from http://delta-intkey.com/www/programs.htm. Once Intkey is installed you need only click on the .ink fi le (below) and the key will open. Click on any character on the left to begin.

More details on how to use Intkey efficiently are found at http://florabase.calm.wa.gov.au/help/keys/intkey_tutorial.pdf

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Appendix 4

Morphological terms matched to the Hymenoptera Anatomy Ontology. Identifiers (URIs) represent anatomical concepts in HAO version http://purl.obolibrary.org/obo/hao/2011-05-18/hao.owl

Term	URI
abscissa	http://purl.obolibrary.org/obo/HAO_0000076
anatomical structures	http://purl.obolibrary.org/obo/HAO_0000003
angle	http://purl.obolibrary.org/obo/HAO_0000285
antenna	http://purl.obolibrary.org/obo/HAO_0000101
antennal insertions	http://purl.obolibrary.org/obo/HAO_0001022
antennomere	http://purl.obolibrary.org/obo/HAO_0000107
area	http://purl.obolibrary.org/obo/HAO_0000146
band	http://purl.obolibrary.org/obo/HAO_0000163
basal lobe	http://purl.obolibrary.org/obo/HAO_0001219
body	http://purl.obolibrary.org/obo/HAO_0000182
carina	http://purl.obolibrary.org/obo/HAO_0000188
cell	http://purl.obolibrary.org/obo/HAO_0001091

Term	URI
costa	http://purl.obolibrary.org/obo/HAO_0000225
coxa, coxae	http://purl.obolibrary.org/obo/HAO_0000228
coxal cavities	http://purl.obolibrary.org/obo/HAO_0000229
crossveins	http://purl.obolibrary.org/obo/HAO_0000236
cubitus	http://purl.obolibrary.org/obo/HAO_0000237
depression	http://purl.obolibrary.org/obo/HAO_0000241
eye	http://purl.obolibrary.org/obo/HAO_0000217
femur	http://purl.obolibrary.org/obo/HAO_0000327
flagellomeres	http://purl.obolibrary.org/obo/HAO_0000342
flange	http://purl.obolibrary.org/obo/HAO_0000344
metasomal foramen	http://purl.obolibrary.org/obo/HAO_0000865
fore leg	http://purl.obolibrary.org/obo/HAO_0000349
fore tarsus	http://purl.obolibrary.org/obo/HAO_0001125
fore tibia	http://purl.obolibrary.org/obo/HAO_0000350
fore wing	http://purl.obolibrary.org/obo/HAO_0000351
frons	http://purl.obolibrary.org/obo/HAO_0001044
galea	http://purl.obolibrary.org/obo/HAO_0000368
gena	http://purl.obolibrary.org/obo/HAO_0000371
groove	http://purl.obolibrary.org/obo/HAO_0001525
head	http://purl.obolibrary.org/obo/HAO_0000397
hind coxa	http://purl.obolibrary.org/obo/HAO_0000587
hind femur	http://purl.obolibrary.org/obo/HAO_0001140
hind leg	http://purl.obolibrary.org/obo/HAO_0000399
hind tibia	http://purl.obolibrary.org/obo/HAO_0000631
hind trochanter	http://purl.obolibrary.org/obo/HAO_0001139
hind wing	http://purl.obolibrary.org/obo/HAO_0000400
labial palpus	http://purl.obolibrary.org/obo/HAO_0000450
labrum	http://purl.obolibrary.org/obo/HAO_0000456
lateral lobes	http://purl.obolibrary.org/obo/HAO_0000466
laterotergite	http://purl.obolibrary.org/obo/HAO_0001861
leg	http://purl.obolibrary.org/obo/HAO_0000494
leg segment	http://purl.obolibrary.org/obo/HAO_0000495
lobe	http://purl.obolibrary.org/obo/HAO_0001587
mandible	http://purl.obolibrary.org/obo/HAO_0000506
margin	http://purl.obolibrary.org/obo/HAO_0000510
median lobe of mesoscutum	
mediotergite	http://purl.obolibrary.org/obo/HAO_0001860
mesoscutum	http://purl.obolibrary.org/obo/HAO_0001490
mesosoma	http://purl.obolibrary.org/obo/HAO_0000576
metapleuron	http://purl.obolibrary.org/obo/HAO_0001271
metasoma	http://purl.obolibrary.org/obo/HAO_0000626
mid femur	http://purl.obolibrary.org/obo/HAO_0001131
mid leg	http://purl.obolibrary.org/obo/HAO_0000636
mid tibia	http://purl.obolibrary.org/obo/HAO_0001351
mouthparts	http://purl.obolibrary.org/obo/HAO_0000639

Term	URI
notaulus	http://purl.obolibrary.org/obo/HAO_0000647
occiput	http://purl.obolibrary.org/obo/HAO_0000658
ocellar triangle	http://purl.obolibrary.org/obo/HAO_0000430
ovipositor	http://purl.obolibrary.org/obo/HAO_0001004
palpus	http://purl.obolibrary.org/obo/HAO_0000683
patch	http://purl.obolibrary.org/obo/HAO_0000704
petiole	http://purl.obolibrary.org/obo/HAO_0000020
pit	http://purl.obolibrary.org/obo/HAO_0000718
posterior scutellar depression	http://purl.obolibrary.org/obo/HAO_0000764
process	http://purl.obolibrary.org/obo/HAO_0000822
projection	http://purl.obolibrary.org/obo/HAO_0000829
pronotum	http://purl.obolibrary.org/obo/HAO_0000853
propleuron	http://purl.obolibrary.org/obo/HAO_0000862
propodeum	http://purl.obolibrary.org/obo/HAO_0001249
prothorax	http://purl.obolibrary.org/obo/HAO_0000874
region	http://purl.obolibrary.org/obo/HAO_0000893
ridge	http://purl.obolibrary.org/obo/HAO_0000899
scape	http://purl.obolibrary.org/obo/HAO_0000908
sclerite	http://purl.obolibrary.org/obo/HAO_0000909
sculpture	http://purl.obolibrary.org/obo/HAO_0000913
scutellum	http://purl.obolibrary.org/obo/HAO_0000572
segment	http://purl.obolibrary.org/obo/HAO_0000929
seta	http://purl.obolibrary.org/obo/HAO_0000935
spot	http://purl.obolibrary.org/obo/HAO_0000704
spur	http://purl.obolibrary.org/obo/HAO_0001018
sternite	http://purl.obolibrary.org/obo/HAO_0000955
stigma	http://purl.obolibrary.org/obo/HAO_0000957
suture	http://purl.obolibrary.org/obo/HAO_0001525
tarsal claw	http://purl.obolibrary.org/obo/HAO_0000989
tarsomeres	http://purl.obolibrary.org/obo/HAO_0000991
tarsus	http://purl.obolibrary.org/obo/HAO_0000992
tegula	http://purl.obolibrary.org/obo/HAO_0000993
tendon	http://purl.obolibrary.org/obo/HAO_0000996
tergum	http://purl.obolibrary.org/obo/HAO_0001006
tergite	http://purl.obolibrary.org/obo/HAO_0001005
thorax	http://purl.obolibrary.org/obo/HAO_0001970
tibia	http://purl.obolibrary.org/obo/HAO_0001017
tibial spur	http://purl.obolibrary.org/obo/HAO_0001018
trochanter	http://purl.obolibrary.org/obo/HAO_0001034
vein	http://purl.obolibrary.org/obo/HAO_0001095
vertex	http://purl.obolibrary.org/obo/HAO_0001077
wing	http://purl.obolibrary.org/obo/HAO_0001089
wing vein	http://purl.obolibrary.org/obo/HAO_0001095